SECTION 02060

WELL AND PIEZOMETER ABANDONMENT
10/97

PART 1 GENERAL

1.1 APPLICABLE STANDARDS AND PUBLICATIONS

The following publications of these issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 150	(1986) Standard Specification for Portland Cement

AMERICAN PETROLEUM INSTITUTE (API)

API SPEC 13A	Specification for Drilling-Fluid Material

Virginia Department of Environmental Quality (VDEQ)

DEQ Guidance Document #01-2024	(2001) Storage Tank Program Technical Manual, Third Edition

1.2 SCOPE

The work provided for herein consists of furnishing all plant, labor, fuels, lubricants, electric energy, materials and equipment, and performing all operations required for the abandonment of groundwater monitoring wells and piezometers, hereinafter collectively referred to as wells, as indicated on the drawings and as specified herein. Some minor hand digging may be required to locate wells.

1.3 QUALITY CONTROL

The Contractor shall establish and maintain quality control for all well abandonments to assure compliance with contract requirements. The Contractor shall maintain records of his quality control for well abandonment, including but not limited to the items listed in paragraph: SUBMITTALS.

1.4 PROTECTION OF EXISTING FACILITIES

The Contractor shall protect all surface and subsurface structures, and surrounding areas from damage which may result from the methods employed in performing this work. The Contractor shall be responsible for any damages to such structures resulting from his operations. Damaged property shall be repaired or replaced at no additional cost to the Government, to a condition which is equal to that which existed prior to the damage. The Contracting Officer shall have the right to approve these restoration measures.

1.5 DOCUMENTATION

For each well, the documents outlined below shall be completed.

1.5.1 Abandonment Diagrams/Logs

An abandonment diagram/log shall be completed for each well abandonment. The scale of the diagram shall be 1 inch equals 4 feet. The diagram shall be prepared by the geologist/hydrogeologist present during well abandonment operations. Submission of the diagrams shall be a Category II (Approval) submittal within 5 working days of the completion of all well abandonments. The well abandonments will not be accepted by the Contracting Officer's Representative before the abandonment diagrams are received. The diagram shall illustrate the as-built condition of the abandonment and include, but not be limited to, the following items:

a. Name of the project and site.

b. Well identification number and location (coordinates).

c. Name of driller and name and signature of the hydrogeologist preparing diagram.

d. Date(s) of abandonment.

e. Original construction.
   1. Description of material from which the well is constructed.
   2. Total depth of well.
   3. Nominal hole diameter.
   4. Depth to top and bottom of screen, filter pack, and any tailpipe installed in the well
   5. Calculated grout volume required.

f. Abandonment data.

   1. Date(s) of abandonment operations.
   2. Depth to water and date measured.
   3. Casing removal.
   4. Method of grouting.
   5. Top and bottom elevations of grout.
   6. Grout mixture (include water).
   7. Grout weight per gallon.
   8. Actual volume of grout used.

1.5.2 Field Notebook

A field notebook shall be kept by the geologist/hydrogeologist present during well abandonment operations. Information recorded in the book shall include, but not be limited to the following:

1. Identification number and location of well
2. To the extent known or measurable, surface and well casing interval, diameter and materials; screen interval, diameter and materials; seal interval and materials.
3. Description of abandoned well including grout mix, intervals, and volume.
4. Description of abandonment methods.
5. Significant observations made during abandonment.
6. Record of materials used during abandonment operations.
7. Geologic and mechanical problems encountered during well abandonment.
8. Weather conditions.
9. Personnel present and visitors to the site.
10. Other information.
11. Daily start up and completion times.
12. Date and sign-off by geologist/hydrogeologist.

1.6 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having and "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01305 SUBMITTAL PROCEDURES.:

SD-01 Data

Abandonment Plan; GA.

A plan describing methods and procedures to be used for abandonment shall be submitted. The plan must be prepared by, or approved and signed by a geologist/hydrogeologist before submittal. The plan shall include, but not be limited to, the following: a description of well abandonment procedures including packer installation and placement of grout; a description of abandonment material; and a description of quality control procedures including depth measurements, placement of grout. Also include example forms for abandonment diagrams/logs.

SD-04 Drawings

Abandonment Diagrams; GA.

SD-09 Reports

Field Notebook; GA.

PART 2 PRODUCTS

2.1 GROUT

Grout for abandonment shall consist of a mixture of 94 pounds of Type II portland cement, 3 to 5 pounds of powdered bentonite and a maximum 7 gallons of water. Bentonite shall be Wyoming-type sodium montomorillonite and shall meet the requirements of API SPEC 13A, Section 5. Cement shall meet the requirements of ASTM C 150-86.

PART 3 EXECUTION

3.1 ABANDONMENT SCHEDULING

Abandonment operations shall be completed before any excavation or embankment activities are performed on site.

3.2 WELLS TO BE ABANDONED

Wells to be abandoned are constructed of 2-inch diameter, schedule 40 PVC casing and well screen with protective steel covers. The locations of the wells to be abandoned are shown on the drawings. The wells to be abandoned are MW3 and MW-4, located on the North side.

3.3 GOVERNMENT FURNISHED DATA

Well logs and/or well installation diagrams are labeled MW-3/SB-17 and MW-4/SB-13 and are attached to specification Section 02072. These data shall be used by the Contractor to complete the requirements of Paragraph: Abandonment Diagrams/Logs.

3.4 ABANDONMENT PROCEDURES

3.4.1 Monitoring Wells

The wells shall be abandoned in accordance with all applicable requirements of DEQ Guidance Document # 01-2024 and the following procedures:

3.4.1.1 Water Levels and Depth Measurements

Water levels shall be measured in each well prior to abandonment operations. Water levels shall be measured and recorded to the nearest 0.01 foot. The total depth of the well shall be determined with a sounding weight and line to ensure the well is free of debris which could hinder abandonment operations.

3.4.1.2 Backfilling

Wells shall be sealed by backfilling under pressure with cement-bentonite grout. Grout shall be placed through a side discharge tremie pipe which is lowered down the inside of the well to within 3 feet of the bottom of the well screen. A packer shall be set between the tremie pipe and the well casing approximately 2 feet below ground surface. A volume of grout equal to the casing volume of the void space in the filter pack and the well screen and riser below the packer shall then be pumped in one continuous operation through the tremie pipe to fill the well screen and casing and the filter pack. The pumping pressure shall be the minimum necessary to force the grout out into the filter pack. The tremie pipe and packer shall then be withdrawn from the well and the remaining volume of the hole filled with grout. Grout shall be periodically added to the hole to maintain the grout level in the well within 3 feet of the ground surface for 24 hours to allow the grout to set.

3.4.1.3 Surface Completion

No sooner than 24 hours after grouting of the well is completed, the protective cover shall be removed. The well riser shall be cut off 1 to 2 feet below ground surface. Grout shall then be added to fill the remaining riser and hole to within 6 inches of the ground surface. After this grout has set sufficiently, the remainder of the hole shall be filled with stone and/or asphalt as required to match the adjacent finished surface. Each protective cover shall be disposed of off site in accordance with SECTION 02220 DEMOLITION.

3.4.1.4 Liquids

All liquid produced during well abandonment operations (i.e., ground water and excess grout purged during grouting) will be considered contaminated. Liquids shall be contained to prevent runoff and saturation into the soils. The liquids shall be collected and disposed of as specified for water removed from within areas of known contamination, in accordance with SECTION 02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL, Paragraph 3.3.3 Contaminated Water.

-- End of Section --

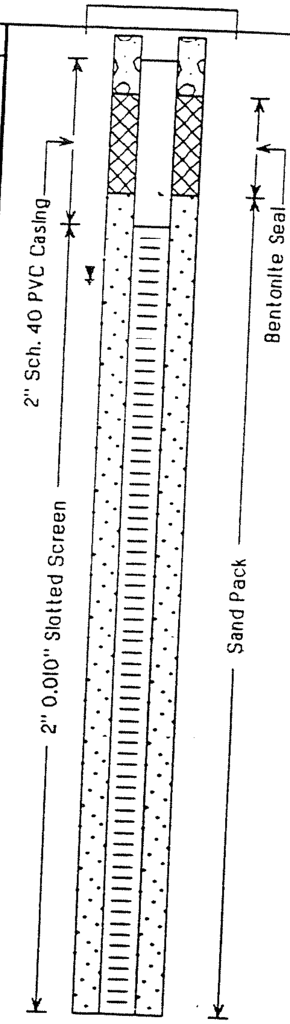
VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-3/SB-17

Depth (ft)	Date	Time	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0									Asphalt
4			1 1 1 2	18"		0			Medium brown coarse to fine SAND no odors
9			1 1 2 2	20"		0			Same as above, wet

Depth scale: 5, 10, 15, 20

Well Contruction Summary



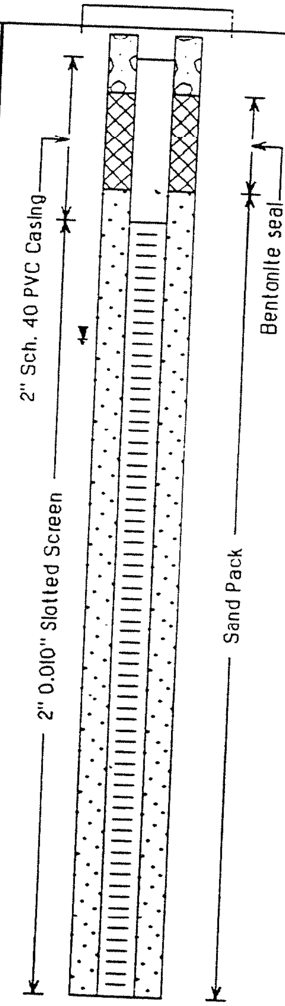
Job Name	Great Bridge North Approach	Date Started	8/21/95	Drill Method	HSA
Job Number	2978.002	Date Completed	8/21/95	Casing Diameter	2"
Client Name	Army Corp of Engineers	Total Depth	14.30 Feet BEG	Screen Interval	3 to 15 Feet BEG
Location	Great Bridge, Virginia	Water Level	3.88 Feet BEG	Slot Size	0.010
Boring Number	MW-3/SB-17	Surface Elevation	MSLD	Drilling Co.	Connelly and Associates
Geologist	Mike Bruzzesi	Signature		Date	

VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-4/SB-13

Depth (ft)	Date	Time	Blows/6'	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0									gravel
									Dark gray coarse to medium SAND
									Light gray coarse to medium SAND
5			1 1 1 2	24"		80			Medium brown coarse to medium SAND with organic matter and strong petroleum odors
10									
15									
20									

Well Contruction Summary



Job Name Great Bridge North Approach
Job Number 2978.002
Client Name Army Corp of Engineers
Location Great Bridge, Virginia
Boring Number MW-4/SB-13
Geologist Mike Bruzzesi

Date Started 8/21/95
Date Completed 8/21/95
Total Depth 14.75 Feet BEG
Water Level 4.84 Feet BEG
Surface Elevation MSLD
Signature

Drill Method HSA
Casing Diameter 2"
Screen Interval 3-15' Feet BEG
Slot Size 0.010
Drilling Co. Connelly and Associates
Date

SECTION 02072
EXCAVATION OF PETROLEUM CONTAMINATED SOIL

NAO ModMaster 10/02

PART # GENERAL

1.1 REFERENCE

The publications listed below form a part of this section to the extent referenced. The publications are referenced in the text by basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API 217	(Jun 1984; 1st Ed) Guidelines for Confined Space Work in the Petroleum Industry

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR Part 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR Part 1926	Safety and Health Regulations for Construction
40 CFR Part 261	Identification and Listing of Hazardous Waste
40 CFR Part 262	Standards Applicable to Generators of Hazardous Waste
40 CFR Part 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR Part 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR Part 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage , and Disposal Facilities
40 CFR Part 266	Standards for the Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities
40 CFR Part 401	Effluent Guidelines and Standards
40 CFR Part 403	General Pretreatment Regulations for Existing and New sources of Pollution
49 CFR Part 172	Hazardous Materials Tables

49 CFR Part 178	Specifications for Packaging
49 CFR Part 302	List of Hazardous Substances and Reportable Quantities

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846	(Nov 1986, 3rd Ed) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II)

CORPS OF ENGINEERS (COE)

ER 1110-1-263	Chemical Data Quality Management for Hazardous Waste Remedial Activities
ER 385-1-92	Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities
EM 385-1-1	(1996) Safety and Health Requirements Manual
EM 200-1-1	(1994) Validation of Analytical Chemistry Laboratories
EM 200-1-3	(Sep 94) Requirements for the Preparation of Sampling and Analysis Plans
EM 200-1-6	(1997) Chemical Quality Assurance

VIRGINIA ADMINISTRATIVE CODE (VAC)

9VAC 20-60	Hazardous Waste Management Regulations
9VAC 20-80	Solid Waste Management Regulations
9VAC 20-80-700	Soil Contaminated with Petroleum Products
9VAC 20-110	Regulations Governing the Transportation of Hazardous Materials
9VAC 25-31	Virginia VPDES General Permit
9VAC 25-120	General Permit for Discharges From Petroleum Contaminated Sites
9VAC 25-180	VPDES Permit for Stormwater Discharge-Construction Sites
9VAC 25-260	Virginia Water Quality Standards

1.2 MEASUREMENT AND PAYMENT

1.2.1 Measurement

a. Suspected or confirmed petroleum contaminated soil for excavation, stockpiling, sampling and testing, and satisfactory borrow material for replacement of confirmed contaminated soil except at locations to receive special backfill for wet environments per Sheets C-22 and C-23 and C-24, shall be measured in cubic yards by calculated volumes of measured interior dimensions of containers, vehicle compartments, or stockpile, as approved by the Contracting Officer (CO). Confirmed petroleum contaminated soil for transportation and disposal shall be measured in tons as indicated on certified weigh tickets from the disposal facility.

1.2.1.1 Payment

Compensation for work covered by this section will be in accordance with the bid schedule.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Work Plan; GA

The Contractor shall develop, implement, maintain, and supervise as part of the work, a comprehensive plan for contaminated soil removal, and stockpiling, contaminated water removal and storage, testing, treatment & disposal, and related operations. The Work Plan shall demonstrate compliance with the contract clauses, referenced standards, this specification, ER 1110-1-263, ER 385-1-92, EM 385-1-1, 9VAC 20-60, 9VAC 20-80, 9VAC 20-110, 9VAC 25-120, 9VAC 25-260, 29 CFR Part 1910.120, and 29 CFR Part 1926.65. No work at the site, with the exception of site inspections and mobilization, shall be performed until the plan is approved. At a minimum the Work Plan shall include:

a. Scheduling and operational sequencing of all work associated with excavations to be performed within and continuing beyond the area of known contamination, as identified on the contract drawings.

b. Detailed description of the excavation, screening for contamination, stockpiling, and disposal procedures. In addition, the Contractor shall provide a detailed drawing, identifying the location of all excavations and stockpiling activities and all exclusion zones, contamination reduction zones, and support zones associated with excavations to be performed within the area of known contamination, as identified on the contract drawings.

c. A Sampling and Analysis Plan, in accordance with ER 1110-1-263, EM 200-1-1, EM 200-1-3, and EM 200-1-6 which describes field screening and sampling methods and applicable quality control procedures, and which lists analytical parameters, methods, and selected laboratory or laboratories including qualifications and quality assurance/control procedures.

d. Identification of applicable regulatory requirements and permits.

e. Methods to be employed for contaminated water removal, storage, sediment removal and treatment, and discharge or disposal, and methods proposed for control of surface water. For on-site sediment removal and treatment, full details of unit process(es), a proposed layout/staging including pumping and piping, manufacturer's operating instructions, and certification of compliance with applicable VDEQ, federal and local regulations, shall be submitted.

f. Identification of waste and contaminated soil and water transporters and means of transportation, and a copy of all State and/or Federal License for hauling.

g. Disposal facilities and alternate disposal facilities and means of disposal or remediation and a copy of all State and/or Federal Permits for treatment and disposal of waste and contaminated soil and water.

h. Borrow source.

i. Spill prevention plan.

j. Spill contingency plan.

k. Decontamination procedures for personnel, equipment, and vehicles entering/exiting the exclusion zone.

l. Methods of measuring quantities of contaminated soil and water for disposal and/or discharge, as applicable.

m. A statement of agreement from the transporter, treatment, storage, and disposal facility operators to accept the specific waste from this work.

SD-08 Statements

Qualifications; GA.

A statement demonstrating that the Contractor performing the excavation within the area of suspected or confirmed contamination, as identified on the contract drawings, meets the requirements in paragraph QUALIFICATIONS. Include owner, owner point of contact with phone number, location of work site, and dates of previous projects.

SD-09 Reports

Test Reports; FIO.

Test results for the fill material, underlying soil, and discharged water. The reports shall include the chain-of-custody records.

SD-18 Records

Shipping Manifest; FIO .

Manifest in accordance with 40 CFR Part 262 Section 23 and 40 CFR Part 263, and 9VAC 20-60 and 9VAC 20-110.

Site Safety and Health Plan GA

There is potential for workers at the site to be exposed to petroleum constituents during excavation and handling and other work in excavation areas. Pursuant to regulations issued by 29 CFR Part 1910.120 and 29 CFR Part 1926.65, the Contractor shall take appropriate measures to safeguard the health of workers at the site. Such measures include apprising workers of the nature of the contaminants at the site, ensuring workers have appropriate training for working at contaminated sites, and preparing and conducting work in accordance with a site specific health and safety plan. The Contractor shall prepare a Site Specific Safety and Health Plan, in accordance with Specification Section 01351 Safety, Health, and Emergency Response for HTRW, which addresses all aspects of worker notification, training, exposure, protective equipment, and other protection at the site.

Permits; FIO.

Provide copies of permits for discharge, transporting, storing, treating, and disposal, as applicable, of wastes and contaminated soil and water.

1.4 QUALIFICATIONS

The Contractor shall have a minimum of two years experience in the removal and disposal of petroleum contaminated soil and water.

1.5 NOTIFICATION

The Contractor shall notify the Contracting Officer (CO) immediately after a suspected contaminant beyond that indicated is encountered.

1.6 AVAILABLE DATA

The data presented and referenced below is the most complete and accurate available, but may not be fully representative of the actual conditions for the entire site. Conditions will vary between sample and test locations. Chemical concentrations may be greater in some project areas than those indicated. An environmental investigation of the South Approach site was performed by, Versar Inc., in August 1995 and on the North Approach in March 1996. Summarized results of the investigation are included as attachments to specification Section 02072. As clarification, reported values in Table 2 for lead in the North Approach soils, are incorrectly shown as ppb; this should be ppm (parts per million). Values listed in Table 3 at the North Approach, represent total parts per billion (ppb) of lead in groundwater. At the South Approach, results for dissolved lead in groundwater, not included in the text excerpts or tables, were as follows: 41 ppb at 94GBW-1; 50 ppb at 94GBW-2; and 78 ppb at 94GBW-3. Copies of the full reports including analytical data summary sheets, are available in the library located on the first floor of the Norfolk District, located at 803

Front Street. Point of contact for the Norfolk District library, Ms. Lane Killam, can be reached at 757-441-7562. In addition to the Versar investigation and Reports, limited groundwater and soil sampling were performed at the bridge pier locations by the Norfolk District Corps of Engineers (COE) in May and June 2000, and by IMS Environmental, Inc. at selected south side utility locations in March and April 2002 and at selected north and south side utility locations in September 2002. Summarized analytical results of the COE sampling, and copies of the IMS investigation report (April) and analytical results (September), are included as attachments to this specification Section. In addition, rising and falling head slug tests were performed at North Approach well MW-2 and at South Approach wells 94GBW-1 and 94GBW-2 by Earth Care Corporation, under contract to Tidewater Skanska Construction, in October 2001. Results using AQTESOLV groundwater modeling software utilizing the Bouwer-Rice method were reported to be 0.00336 feet per minute for the area around MW-2 and averaged 0.000943 feet per minute for the areas around 94GBW-1 and 94GBW-2.

1.7 ENVIRONMENTAL PROTECTION

The Contractor shall take necessary measures specified herein, shown in Section 01560, and otherwise required, to protect the environment.

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL

Backfill material shall be as specified in Section 02221 EARTHWORK, Section 02222 Excavation, Trenching and Backfilling For Utilities Systems, and Section 02225 Subgrade and Shoulders, as applicable to the type of excavation. Material removed from the excavation can be used for backfill in accordance with paragraph BACKFILLING, if it meets the soils classifications listed in the applicable specification section(s) above and it it meets the requirements for clean fill as identified in 9VAC 20-8-700.

2.2 CONTAINERS FOR HAZARDOUS WASTE

Containers for hazardous waste shall comply with 49 CFR Part 178.

PART 3 EXECUTION

The Contractor shall be responsible for obtaining all necessary permits as required to perform the work as indicated and specified, and the Government shall be held harmless for any associated delays or costs incurred by the Contractor.

3.1 SAFETY

The Contractor shall identify an exclusion zone and all personnel working inside and in the general vicinity of the exclusion zone shall be trained and thoroughly familiar with the safety precautions, procedures, and equipment required for controlling potential hazards associated with this work. Personnel shall use proper protection and safety equipment during work in and around the excavation in accordance with the approved Site Safety and Health Plan, and as otherwise specified.

3.2 SOIL EXAMINATION, TESTING, AND ANALYSIS

3.2.1 Soil Examination

The Contractor shall examine the soil within the project site and shall immediately notify the CO of suspected soil contamination beyond that indicated, and all work within the area of suspected contamination shall be stopped as soon as practicable. As soon as practicable is defined as securing and protecting all open trenches and equipment, and providing measures to prevent contamination of other soil or water. The Contractor shall not perform any additional work in the area of suspected contamination, until notified, in writing, by the CO.

3.2.2 Stockpiled Material Sampling

Stockpiled contaminated and suspected contaminated soil shall be sampled in accordance with 9VAC 20-80, and preserved in accordance with EPA SW-846. For VOC analysis, a minimum of one discrete sample shall be collected from within the stockpile.

3.2.3 Testing and Analysis

Soil samples from the stockpiled material shall be tested in accordance with EPA SW-846, 9VAC 20-60, and 9VAC 20-80, as modified herein for the following:

a. GRO/TPH by EPA Method 5035/8015 modified;

b. DRO/TPH by EPA Method 3550/8015 modified;

c. Benzene, ethylbenzene, toluene, xylene (BTEX) by EPA Method 5035/ 8021B;

d. toxicity characteristic leaching procedure (TCLP) by EPA Method 1311 for lead by EPA Method 6010/7000;

e. Total organic halogens (TOX) by EPA method 9020;

f. Paint filter liquids by EPA Method 9095;

g. All additional analyses as may be required by the approved off-site disposal facility.

3.2.4 Test Results

Copies of all test results shall be provided to the CO. The testing laboratory and Contractor shall adhere to the quality control program, including detection limits, spikes, blanks, and duplicates, of EPA SW-846 and EM 200-1-3 as applicable. All additional testing required by the disposal or treatment facility shall be at the Contractor's expense.

3.3 EXCAVATION

Excavation and dewatering shall be strictly limited to the extent necessary to properly and safely complete the work as indicated and specified. Excavation and dewatering shall be performed as noted on contract drawing Sheet B-7 entitled "Petroleum Contaminated Soil", and as indicated and specified.

3.3.1 Open Excavations

Open excavations and stockpile areas shall be secured while awaiting test results. The excavation shall not be backfilled without approval from the CO. The Contractor shall divert surface water around excavations, and shall cover the excavation to the extent practicable when rainfall is anticipated, to prevent water from directly entering into the excavation.

3.3.2 Stockpiles

a. Monitoring Excavated Material

Excavation shall be performed in a manner that will limit the amount of potentially contaminated soil that could be mixed with previously uncontaminated soil. Continuous monitoring of all excavation work shall be accomplished with an organic vapor analyzer photoionization device or flame ionization detector (OVA/PID/FID) capable of detecting volatile, semi-volatile and organic vapors to a minimum of one part per million (ppm).

b. Stained, Volatile, and/or Odorous Excavated Material

Excavated material which is visibly stained or for which real time vapor monitoring instrument readings exceed background levels by more than 10 ppm for volatile and semi-volatile hydrocarbons and which has an obvious petroleum odor shall be considered contaminated and shall be stockpiled for sampling in accordance with paragraph Stockpiling Contaminated Soil and paragraph Stockpile Material Sampling.

c. Stockpiling Contaminated Soil

Contaminated soil shall be placed on an impermeable geomembrane a minimum of 30 mils thick or on two (2) layers each a minimum of 10 mils thick, and covered with a 10 mil sheet of geomembrane. The geomembrane shall be placed such that the stockpiled soil does not come in contact with surface water run-off. The 10 mil geomembrane cover shall prevent rain or surface water from coming into contact with the contaminated soil, as well as limit the escape of the volatile constituents in the stockpile. Contaminated soil may be stockpiled in roll-offs, approved for storage of hazardous waste.

3.3.3 Contaminated Water

All water removed from any excavation performed within the areas of known contamination as identified on contract drawing Sheet B-7 shall be considered to exceed the Virginia permitted discharge concentrations, and all costs from collection to final discharge or disposal shall be included in the Contractor's lump sum price for Bid Item 1. For water requiring removal from excavations beyond the indicated limits of known contamination, the Contractor's lump sum price for Bid Item 1 shall include all costs from collection to discharge, for discharge to the AIWW public waters or at other approved locations on site as specified in this Section and in Section 01560 ENVIRONMENTAL PROTECTION and as permitted under 9VAC 25-31, 9VAC 25-180, and 9VAC 25-260. Water removed from any excavation performed within the indicated areas of known contamination, as identified on the contract drawings, shall be contained and stored on-site and shall be sampled and analyzed prior to being discharged as permitted after all necessary treatment or prior to being transported for off-site disposal. Water that will be treated for permitted discharge shall be stored in a sedimentation tank fitted with a bag filter or equivalent system at the outlet, as necessary to minimize solids that will be passed to the downgradient treatment system and/or discharge receiving waters. No Government facilities shall be used for storage of the water. The Contractor shall provide approved containers, vehicles, equipment, labor, signs, placards, labels, and manifests necessary for accomplishment of the work, including materials necessary for cleaning up spills that could occur from the excavation operation.

3.3.4 Contaminated Water Disposal

a. Sample and Analysis

Contaminated water shall be sampled and analyzed, and certified results received, prior to discharge or disposal. Analytical results for water discharged to the AIWW public waters or other permitted locations shall be furnished within 72 hours of sample collection. Documentation of all analysis performed shall be furnished to the Contracting Officer in accordance with Paragraph RECORDS. Type and frequency of analyses for contaminated water to be taken to an off-site treatment, storage and disposal (TSD) facility shall conform to the requirements of the TSD facility. Type and frequency of analyses for contaminated water to be discharged to the AIWW public waters or other permitted location shall conform to the permit requirements of 9VAC 25-120 for gasoline contaminated water to be discharged to saltwater receiving waters, except as modified by the permitting agency. Sampling and analyses of contaminated water and treated water, and the Contractor and laboratory quality assurance programs, shall be in accordance with the approved Sampling and Analysis Plan.

b. Treatment and Disposal

Water that cannot be discharged into the AIWW public waters or other permitted location without causing a violation of 9VAC 25-120 or 9VAC25-260 or Section 01560, shall be treated as necessary for permitted discharge compliance, or shall be transported for treatment and disposal by an approved off-site TSD facility. The selection of on-site treatment and discharge versus transporting and off-site disposal, shall be solely at the Contractor's risk and responsibility and the Government shall assume no responsibility for any lack of data or for any assumptions made by the Contractor. When the contaminated water is to be treated on site for discharge, it shall be passed through a carbon filtration and/or other appropriate treatment system placed downstream of the specified sedimentation tank/filtering system. The Contractor shall be solely responsible for the selection, operation, and effectiveness of the sedimentation tank and filtering/treatment systems components. The proposed treatment, including methods for separation and disposal of free product if encountered, shall be included in the Work Plan, and the resulting compliant water shall be discharged as specified below for discharge of uncontaminated water. For water to be taken to an off-site TSD facility, the Contractor shall transport, treat, and dispose of the water in accordance with applicable requirements of 40 CFR 263, 40 CFR 264, 40 CFR 401, 9VAC 20-80, 9VAC 20-110, and 9VAC 25-260.

3.3.5 Discharge of Uncontaminated Water

Water that meets the applicable requirements of 9VAC 25-120 (saltwater receiving waters) and 9VAC 25-260, specification Section 01560, and VPDES permit per 9VAC 25-31 and 9VAC 25-180, may be discharged into the AIWW public waters or other permitted locations at the site. Discharge will not be allowed into any storm or sanitary sewer systems. Discharge location and methods and sediment removal procedures shall minimize disturbance to the receiving media in accordance with the specifications and applicable permits, and shall be approved prior to implementation. For any non-compliance, discharge shall be halted and measures shall be taken as necessary to comply with the applicable specification and permit requirements.

3.4 BACKFILLING

Bedding and backfill for utilities shall be as noted on contract drawing Sheet B-7. The excavation shall be backfilled with specified Backfill Material only after the applicable chemical and soil classification test results have been approved. When directed, the bottom of the excavation at confirmed contaminated locations encountered outside of the indicated limits of known contamination shall be backfilled to the standing groundwater level with approved stone material, in lieu of dewatering and disposing of contaminated water. Backfilling shall be in accordance with applicable portions of Section 02221 EARTHWORK and Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, and Section 02225 SUBGRADE AND SHOULDERS.

3.5 CONTAMINATED SOIL AND HAZARDOUS WASTE DISPOSAL GUIDELINES

3.5.1 General

Disposal of soil confirmed by sampling and analysis as contaminated with petroleum products shall be in accordance with 9VAC 20-80 and requirements specified herein. Disposal of all other confirmed contaminated soil and hazardous waste materials shall be in accordance with all applicable Federal, Commonwealth of Virginia, and local solid and hazardous waste laws and regulations.

3.5.2 Transportation of Wastes

Transportation of hazardous waste or petroleum contaminated (special) waste shall comply with applicable requirements of 40 CFR 263, 9VAC 20-60, 9VAC 20-80, and 9VAC 20-110, and regulations of any other authority having jurisdiction when transported across Virginia state lines.

3.5.3 Records

Records shall be maintained of all waste determinations, including appropriate results of analyses performed, substances and sample locations, the time of collection, and other pertinent data as required by 40 CFR Part 262 Subpart D and 9VAC 20-60 or 9VAC 20-80 as applicable. Transportation, treatment, disposal methods and dates, the quantities of waste, the names and addresses of each transporter and the treatment, storage, and disposal facility shall also be recorded and available for inspection, as well as copies or originals of the following documents:

a. Manifests

b. Waste analyses or waste profile sheets

c. Certifications of final treatment/disposal signed by the responsible disposal facility official

d. Weighing scale receipt corresponding to each manifest

Following contract close out, the records shall become the property of the Government.

3.5.4 Hazardous/Special Waste Manifests

For hazardous or special waste, the Contractor shall utilize a Commonwealth of Virginia approved manifest system in conformance with 9VAC 20-60 and CFR 40 Part 262, or 9VAC 20-80 and CFR 40 Part 263, respectively so that the waste can be tracked from generation to ultimate disposal. The Contractor shall prepare the manifests, complete. On the day before shipment, the Contractor shall submit to the Contracting Officer (CO), phone: 757-547-2253, a sample manifest, complete with all information that will be included on the actual manifest less quantities, for review and comment. On the day of shipment, the completed manifest shall be supplied to the CO. If applicable, the CO or his representative will supply the generator number and sign the Generator's Certification if the manifest is accepted. If not acceptable, the Contractor shall make all corrections at no additional cost to the Government.

3.5.5 Documentation of Treatment or Disposal

a. Documentation

The waste shall be taken to a treatment, storage, or disposal facility which complies with 9VAC 20-60 or 9VAC 20-80, as applicable. The Contractor shall provide documentation of acceptance of special waste or hazardous waste by the original return copy of the hazardous waste manifest, signed by the owner or operator of a facility legally permitted to treat or dispose of those materials. If the Contractor selects a different facility than is identified in the approved Work Plan, documentation shall be provided for approval to certify that the facility is authorized and meets the standards specified.

b. Payment

There will be no payment for excavation, transportation, and disposal of contaminated soils for which the transportation, disposal, and weight are not documented by the specified material manifest and corresponding weighing scale receipt and other information specified in paragraph RECORDS.

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-- End of Section --

Versar INC

GEOENVIRONMENTAL ASSESSMENT OF THE BRIDGE CORRIDOR
GREAT BRIDGE BRIDGE REPLACEMENT
CHESAPEAKE, VIRGINIA

1.0 INTRODUCTION

Versar conducted a GeoEnvironmental Assessment of the Bridge Corridor (GEA) in August 1996 for the U.S. Army Corps of Engineers, Norfolk District (Corps), as part of the on-going Great Bridge Bridge Replacement (GBBR) study in Chesapeake, Virginia. The investigation was conducted in accordance with the delivery order scope of work under Corps Contract No. DACA65-95-D-0064. The GEA was performed to address two potential concerns identified during previously conducted investigations at the site. Based on the earlier investigations, backfill material beneath the site may impede proposed GBBR sheeting and shoring activities and petroleum constituents associated with petroleum storage on adjacent properties may have impacted areas designated for excavation.

The GEA consisted of: performing a visual inspection of the properties surrounding the site; conducting a background records search at the Commonwealth of Virginia Department of Environmental Quality (DEQ); excavating soil test pits; drilling soil test borings; and collecting soil samples for field and laboratory analysis. The GEA was conducted to:

- identify potential off-site sources of petroleum contamination identified at the site;
- confirm if backfill beneath the site will impede proposed sheeting and shoring activities; and
- evaluate soil quality in the shallow subsurface within areas of proposed excavation.

This report summarizes Versar's field observations and laboratory results.

2.0 SITE DESCRIPTION AND LOCATION

The site consists of the sections of Battlefield Boulevard (Route 168) located immediately north and south of the Elizabeth River Bridge located in Chesapeake, Virginia (Figure 1). The site is entirely covered by asphaltic pavement and is located in a predominantly commercial area with some single-family residences located to the southeast and northwest. The site is immediately bounded to the north and south by roadway (Battlefield Boulevard) and to the east and west by shoulder comprised of grass, gravel, and/or dirt. Numerous commercial establishments are located beyond the shoulder to the northwest, southwest, and southeast. Undeveloped marsh land is located beyond the shoulder to the northeast. An area map is included as Figure 2.

According to the United States Geological Survey (USGS) 7.5-minute series Fentress, Virginia, Quadrangle Topographic Map, dated 1968 (Figure 1, Appendix A), the site lies approximately 5 feet above mean sea level (msl). The nearest surface water body, the Southern Branch of the Elizabeth River (the "River"), separates the northern and southern parts of the site. The Albemarle/Chesapeake Canal (Intracoastal Waterway) is located approximately 1,000 feet south of the site. Stormwater runoff from the site is conveyed into storm drains located on either side of the roadway into a drainage system that eventually discharges into the River and Intracoastal Waterway.

3.0 GEOLOGY AND HYDROGEOLOGY

The site is located within the Coastal Plain physiographic province, which is generally composed of unconsolidated marine sediments that thicken and gently dip eastward. According to the Geologic Map and Cross Sections of the Coastal Plain and Adjacent Parts of the Piedmont, Virginia (Mixon, et al., 1989), the site is underlain by Upper Pleistocene Age interbedded pebbly, sand, silt, and clay deposits of the Sedgefield Member of the Tabb Formation. These sediments are believed to be surficial deposits of riverine, estuarine, and coastal terraces and plains origin, deposited during interglacial high stands of the sea. In addition, many areas of the site may contain imported fill associated with past bridge, bulkhead, and roadway construction activities.

Based on observations made during excavating and drilling, the subsurface materials encountered beneath the site consisted of layered asphaltic pavement, gravel, and medium sand to a maximum explored depth of 5.75 feet below existing grade (beg). These materials are most likely fill associated with past bridge, bulkhead, and roadway construction activities. Lithologic logs for the soil test pits and soil test borings are contained in Appendix A.

Groundwater was encountered beneath the site at a depth of approximately 5.5 to 5.75 feet beg. Based on its proximity to the River, shallow groundwater flow beneath the site is believed to be towards the River; however, the shallow groundwater beneath the site is most likely subject to tidal influence (measured at more than 4 feet between low and high tides).

4.0 PREVIOUS INVESTIGATIONS

In May 1996, two geotechnical soil test borings (designated PC-1 and PC-2) were drilled under the direction of the Corps for the GBBR project on the northern and southern sides of the bridge. The borings were drilled using a mobile drill rig fitted with hollow stem augers (HSA) to a maximum depth of 3 feet beg. Soil samples were collected continuously using split-spoon barrel samplers. A Corps engineer visually interpreted (i.e., texture, color, consistency, etc.) and logged the split-spoon samples. A petroleum odor was noted within the sample collected from 3 feet beg in boring PC-1 (drilled on the northern side of the bridge). Boring logs for the Corps borings prepared by Versar based on the Corps field notes are contained within Appendix A.

5.0 VISUAL INSPECTION

On August 9, 1996, a Versar scientist conducted a visual inspection of properties and businesses located within the vicinity of the site. The survey was conducted to identify potential sources of contamination identified at the site (Section 4.0). The 100 through 400 blocks of North Battlefield Boulevard were investigated. As previously mentioned, the area surrounding site is primarily of commercial use, with shopping centers and business parks located on either side of Battlefield Boulevard (Figure 2).

The Harbor Watch Shoppes, located on the Northwestern side of the bridge, contained various restaurants, gift shops, mail service companies, and realtors. Battlefield Shopping Center, located further to the north on the western side of Battlefield Boulevard, includes a billiards center, dive center, dry cleaner, and various restaurants. Cabco Automotive Center is located along Wayne Avenue, on the southwest corner of the Harbor Watch Shoppes. Automotive repairs are currently conducted at this center. The property across Battlefield Boulevard to the east is undeveloped and is covered with grass, small trees, and marsh land.

Another shopping center, the Island Wharf Shopping Center, lies on the southeastern side of the bridge and includes a restaurant, tanning salon, veterinarian, grooming center, comic book collectors store, and Tae Kwon Do center. Evidence of soil borings and groundwater monitoring wells were observed on this property. A small produce stand is located south of the shopping center. A small strip of retail shops lies farther south along the eastern side of Battlefield Boulevard and includes a used car sales lot, furniture store, and antique shop. A marina, realtor, restaurant, and office park are located south of the bridge along the western side of Battlefield Boulevard. The office park is bordered on the northern side by the River.

Based on Versar's visual inspection, the current occupants of the properties do not appear to pose an environmental threat to the site; however, evidence of soil test borings and the presence of groundwater monitoring wells at the Island Wharf Shopping Center may indicate that soil and groundwater beneath this property has been impacted.

6.0 BACKGROUND RECORDS SEARCH

On August 9, 1996, a Versar scientist conducted a records search at the DEQ facility located at 5636 Southern Boulevard in Virginia Beach, Virginia. The current Pollution Control (PC) listings of all active and closed incidents in the vicinity of the site (100 through 400 blocks of Battlefield Boulevard) were reviewed. Based on Versar's review, three PC incidents have occurred in the vicinity of the site: the Battlefield Shopping Center (located at 234 N. Battlefield Boulevard), GTE (located at 401 N. Battlefield Boulevard), and Firestone (located at 453 N. Battlefield Boulevard) properties. The PC incidents at each property are summarized in the following sections.

Battlefield Shopping Center (PC No. 92-1033)

On August 9, 1992, a 550-gallon heating oil UST was excavated and removed from this property by Petrochem Recovery Services of Norfolk, Virginia. Based on the results of soil samples collected from the excavation, the DEQ closed the case on August 13, 1994. This property is located approximately 800 feet northwest of the site.

GTE (PC No. 93-1147)

On November 20, 1992, one 550 gallon diesel and one 2,000-gallon heating oil UST were removed from this property. This property is located approximately 2,800 feet north-northeast of the site. Petroleum-impacted soils at concentrations above DEQ soil quality standards were detected in soil samples collected from the excavation. Based on these results, the DEQ required a Site Characterization Report (SCR) be prepared for the property. The site characterization activities included the drilling of five soil test borings and installation and sampling of four groundwater monitoring wells. This property is located approximately 2,800 feet north-northeast of the site.

Based on the results of soil and groundwater sampling, the DEQ closed the case on August 17, 1994; however petroleum constituents were detected in soil and groundwater samples collected during the site characterization activities. According to the DEQ, the case was closed because the sources of contamination were removed (the tanks) and the levels of petroleum constituents present in the soils and groundwater did not pose a threat to the public or the environment.

Firestone (PC No. 93-2150)

On May 5, 1993, a 1000-gallon used motor oil UST was removed from this property. The property is located approximately 3,700 feet north-northeast of the site. Three groundwater monitoring wells were installed around the excavation then sampled. Based on the results of soil samples collected from the excavation and groundwater sampling results from the wells, the DEQ closed the case (date of closure unknown). This property is located approximately 3,700 feet north-northeast of the site.

The DEQ files did not contain any information concerning the investigation (i.e., evidence of soil test borings and existing groundwater monitoring wells) performed at the Island Wharf Shopping Center. According to DEQ Senior Geologist, Mr. Patrick Fly, he had been informed of their presence last year. It is thought that the borings and wells were completed as part of a property transfer assessment and they do not automatically indicate contamination is present at the property. The shopping center appeared to be relatively new, and the current occupants of the property do not appear to pose an environmental threat to the site.

7.0 SUBSURFACE INVESTIGATION

The subsurface investigation (SI) included excavating three soil test pits, drilling two soil test borings, and collecting representative soil samples for field and laboratory analysis. The soil test pits and borings were completed to characterize soil conditions (i.e., lithology and soil quality) beneath the site. The details of the SI are summarized in the following sections.

7.1 Soil Test Pit Excavation

On August 27 and 28, 1996, three soil test pits (designated TP-1 through TP-3) were excavated at the site. The test pit locations are depicted on Figure 4. The test pits were excavated by IMS Environmental (IMS) of Norfolk, Virginia, under the direction of a Versar geologist. The test pits were excavated using a backhoe to a maximum depth of 5.75 feet beg. Soil samples were collected continuously from the backhoe bucket. Subsurface materials encountered during investigation activities consisted of asphaltic pavement, gravel, and sands to a maximum explored depth of 5.75 feet beg. No rip-rap or other large construction or demolition debris was encountered. Test pit logs are included in Appendix A.

Each soil sample collected for field and potential laboratory analysis was split in half. One half of the sample was prepared for field screening by loosely filling a 1-quart sealable plastic bag half full, and allowing the sample to equilibrate for 15 minutes. The other half of each sample was immediately prepared for potential laboratory analysis by tightly packing the soil into two 4-ounce jar (no headspace), closing the jar with a Teflon-lined cap, and placing the sample on ice. Soil samples were screened in the field with a photo-ionization detector (PID) to check for the presence of volatile organic compounds (VOCs).

Visual signs of petroleum impact or petroleum odors were not noted in any of the collected soil samples. Based on the field observations, the deepest collected soil sample from each test pit was submitted for laboratory analysis. The samples were submitted to EA Laboratories (EA) of Sparks, Maryland, for analysis for diesel and gasoline range total petroleum hydrocarbons (TPH) using EPA Method 8015 modified and benzene, toluene, ethylbenzene, and total xylenes (BTEX) using EPA Method 8020.

The soil test pits were backfilled with sand excavated from each respective pit and imported gravel fill. The sand and fill was compacted in lifts no greater than 8 inches. The disturbed areas were resurfaced to grade with asphaltic pavement. These activities were conducted according to applicable City of Chesapeake roadway guidelines. A City of Chesapeake representative was also on-site during the excavation, backfilling, and resurfacing activities.

7.2 Soil Test Boring Drilling

On August 29, 1996, direct-push sampling methods were used to collect soil samples from two locations (designated SB-1 and SB-2). The direct-push sampling locations are depicted on Figure 4. The direct-push samples were collected by IMS, under the direction of a Versar geologist. Sampling was conducted until the soil/groundwater interface was encountered. The maximum depth of sampling was 5.75 feet beg. Soil samples were collected continuously using a stainless steel slit-spoon barrel sampler fitted with an inner polyvinyl chloride (PVC) liner. Subsurface materials encountered during investigation activities consisted of asphaltic pavement, gravel, and sands to a maximum explored depth of 5.75 feet beg. No rip-rap or other large construction or demolition debris was encountered. Boring logs are included in Appendix A.

Each soil sample collected for field and potential laboratory analysis was split in half. One half of the sample was prepared for field screening by loosely filling a 1-quart sealable plastic bag half full, and allowing the sample to equilibrate for 15 minutes. The other half of each sample was immediately prepared for potential laboratory analysis by tightly packing the soil into two 4-ounce jars (no headspace), closing the jar with a Teflon-lined cap, and placing the sample on ice. Soil samples were screened in the field with a PID to check for the presence of VOCs.

Visual signs of petroleum impact or petroleum odors were not noted in any of the collected soil samples. Based on the field observations, the soil sample collected from the soil/water interface from each of the soil test borings was submitted for laboratory analysis. The samples were submitted to EA for analysis of diesel and gasoline range TPH using EPA Method 8015 modified and BTEX using EPA Method 8020.

The soil test borings were backfilled with bentonite and resurfaced to grade with asphaltic pavement.

7.3 Soil Sampling Results

VOCs were not detected during field screening with the PID and TPH (diesel and gasoline ranges) and BTEX were not detected in any of the submitted samples. The field screening results are summarized on the boring logs included in Appendix A and laboratory reports of analysis and associated chain of custody form are included as Appendix B.

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8.0 QUALITY ASSURANCE

Field procedures for this project were conducted following Versar's Field Protocol for the investigation of potentially impacted sites. Methods and procedures for sample collection, sample handling, field documentation, and quality assurance (QA) were strictly adhered to during this project. Samples collected were appropriately labeled and given a unique sample identification number. Samples were documented and were accompanied by a chain of custody form when submitted to the laboratory for analysis.

9.0 CONCLUSIONS

Based on the results of the SI activities, the only potential off-site source of contamination is the Island Wharf Shopping Center (i.e., based on the evidence of a past subsurface investigation) located southeast of the site. It is thought that the investigation was completed as part of a property transfer assessment and does not automatically indicate contamination is present at the property. The shopping center appeared to be relatively new, and the current occupants of the property do not appear to pose an environmental threat to the site. None of the qualitative observations made during this investigation suggests that backfill beneath the roadway will impede proposed sheeting and shoring activities. Petroleum constituents were not detected within the investigated shallow soils (upper 5 feet) within areas of proposed excavation.

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APPENDIX A

TEST PIT AND SOIL TEST BORING LOGS

BORING PC-1

DATE DRILLED: 04/09/96

DEPTH IN FEET	SAMPLE NUMBER	BLOWS/Ft.	PID (ppm)	SAMPLES	SYMBOLS	DESCRIPTION
						Asphaltic Pavement to 0.5 feet.
					GW	GRAVEL.
					SW	Fine SAND.
						CONCRETE/Soil Cement.
					SW	Dark Brown to Light Gray medium SAND with some fine Gravel.
						Petroleum odors observed at 2.83 to 3 feet.
5						

Auger refusal experienced at 3 feet.

BORING PC-2

DATE DRILLED: 04/09/96

DEPTH IN FEET	SAMPLE NUMBER	BLOWS/Ft.	PID (ppm)	SAMPLES	SYMBOLS	DESCRIPTION
						Asphaltic Pavement to 0.75 feet.
					GW	Coarse GRAVEL and COBBLE
5						

Auger refusal experienced at 1.75 feet.

VERSAR Inc. Environmental Risk Management	LOG FOR BORINGS PC-1 AND PC-2 GEA of Bridge Corridor Chesapeake, Virginia	SOIL BORING REPORT

TEST PIT TP-1

DATE EXCAVATED: 08/27/96

DEPTH IN FEET

SAMPLE NUMBER	BLOWS/FT.	PID (ppm)	SAMPLES
TP-1 (3)	NA	0	☒
TP-1 (4)	NA	0	☒
TP-1 (5)	NA	0	☒

SYMBOLS	DESCRIPTION
GW	Asphaltic Pavement to 0.25 feet.
	GRAVEL BASE
	Layered Asphaltic Pavement.
GP	Large GRAVEL/ROCK (2 to 4-inch diameter), some Fine to Coarse SAND. Highly compacted and rigid
SW	TAN medium to coarse SAND.

Test Pit Terminated at 5.25 feet.
Groundwater was not encountered.

TEST PIT TP-2

DATE EXCAVATED: 08/27/96

DEPTH IN FEET

SAMPLE NUMBER	BLOWS/FT.	PID (ppm)	SAMPLES
TP-2 (4)	NA	0	☒
TP-2 (5)	NA	0	☒

SYMBOLS	DESCRIPTION
GW	Asphaltic Pavement to 0.25 feet.
	GRAVEL BASE
GP	Layered Asphaltic Pavement.
SW	Large GRAVEL/ROCK (2 to 4-inch diameter), some Fine to Coarse SAND. Highly compacted and rigid
	TAN medium to coarse SAND.

Test Pit Terminated at 5.67 feet.
Groundwater was not encountered.

VERSAR Inc. Environmental Risk Management	LOG FOR TEST PITS TP-1 AND TP-2 GEA of Bridge Corridor Chesapeake, Virginia	TEST PIT REPORT

TEST PIT TP-3

DATE EXCAVATED: 06/28/96

DEPTH IN FEET

SAMPLE NUMBER	BLOWS/FT	PID (ppm)	SAMPLES	SYMBOLS	DESCRIPTION
					Layered Asphaltic Pavement.
				GP	Large GRAVEL/ROCK (2 to 4-inch diameter), some Fine to Coarse SAND. Highly compacted and rigid.
TP-3 (3)	NA	0	☒	SW	TAN medium to coarse SAND.
TP-3 (5)	NA	0	☒		

5

Test Pit Terminated at 5 feet.
Groundwater was not encountered.

VERSAR Inc.
Environmental
Risk Management

LOG FOR TEST PIT TP-3
GEA of Bridge Corridor
Chesapeake, Virginia

TEST PIT REPORT

BORING SB-1

DATE DRILLED: 08/29/96

DEPTH IN FEET

SAMPLE NUMBER	BLOWS/Ft.	PID (ppm)
SB1 (4)	NA	0

SAMPLES | SYMBOLS | DESCRIPTION

Symbol	Description
	Asphaltic Pavement to 0.25 feet.
GW	Large GRAVEL/ROCK (2 to 4-inch diameter), some Fine to Coarse SAND. Highly compacted and rigid.
SW	TAN medium to coarse SAND.
	As Above, wet aty 5 feet.

Test Pit Terminated at 5.75 feet.

BORING SB-2

DATE DRILLED: 08/29/96

DEPTH IN FEET

SAMPLE NUMBER	BLOWS/Ft.	PID (ppm)
SB2 (5)	NA	0

SAMPLES | SYMBOLS | DESCRIPTION

Symbol	Description
	Asphaltic Pavement to 0.25 feet.
GW	Large GRAVEL/ROCK (2 to 4-inch diameter), some Fine to Coarse SAND. Highly compacted and rigid.
SW	TAN medium to coarse SAND.
	As Above, wet at 5.5 feet.

Test Pit Terminated at 5.75 feet.

VERSAR Inc.
Environmental Risk Management

LOG FOR BORINGS SB-1 AND SB-2
GEA of Bridge Corridor
Chesapeake, Virginia

SOIL BORING REPORT

Summary Table 1. TPH and BTEX results for samples in report 961408. Page 1 of 1

Analyte	Units	9612701 TP-1 (5.3) 08/27/96				9612702 TP-2 (5.8) 08/28/96				9612703 TP-3 (5) 08/28/96				9612704 SB-1 (4-5) 08/29/96				9612705 SB-2 (4.5-5.5) 08/29/96			
		Result	Qual	Limit	Dil	Result	Qual	Limit	Dil	Result	Qual	Limit	Dil	Result	Qual	Limit	Dil	Result	Qual	Limit	Dil
TPH, diesel-range	mg/kg	31	U	31	1.0	27	U	27	1.0	31	U	31	1.0	27	U	27	1.0	26	U	26	1.0
TPH, gasoline-range	ug/kg	120	U	120	1.0	110	U	110	1.0	120	U	120	1.0	110	U	110	1.0	100	U	100	1.0
Benzene	ug/kg	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.0	U	1.0	1.0
Ethylbenzene	ug/kg	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.0	U	1.0	1.0
m-Xylene + p-Xylene	ug/kg	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.0	U	1.0	1.0
o-Xylene	ug/kg	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.0	U	1.0	1.0
Toluene	ug/kg	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.2	U	1.2	1.0	1.1	U	1.1	1.0	1.0	U	1.0	1.0

U = Not detected J = Estimated B = Found in blank D = Diluted E = Outside of calibration range

02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL

North Approach

Versar INC

SITE CHARACTERIZATION REPORT
GREAT BRIDGE BRIDGE-NORTH APPROACH SITE
CHESAPEAKE, VIRGINIA

1.0 INTRODUCTION

The Norfolk District, U.S. Army Corps of Engineers (Corps) retained Versar, Inc., to prepare a Site Characterization Report (SCR) for the Great Bridge Bridge-North Approach site located in Chesapeake, Virginia. The purpose of this site characterization is to determine the degree of petroleum impact to shallow soils and groundwater from former on- and off-site activities and petroleum aboveground storage tanks (ASTs) and underground storage tanks (USTs). The site characterization activities performed include drilling twenty-three soil test borings, installing five groundwater monitoring wells, collecting soil and groundwater samples for laboratory analysis, conducting a magnetic and metal detector survey, and preparing this SCR, including a site, risk, and remediation assessment. The SCR was prepared in accordance with the Commonwealth of Virginia Department of Environmental Quality (DEQ) Petroleum Program Manual, effective March 1, 1995.

2.0 SITE ASSESSMENT

2.1 Site Location and Description

The Great Bridge Bridge-North Approach site (the "site") is located on the northern side of the Albemarle/Chesapeake Canal (Intracoastal Waterway), near the northern approach of the Great Bridge Bridge in Chesapeake, Virginia (Figure 1, Appendix A). The site is bounded to the north by Watson Road, to the west by Battlefield Boulevard (Route 168), to the south by the Intracoastal Waterway, to the east by a single-family residence, a two-story structure occupied by small commercial establishments and single-family apartments, and a trailer park. The site encompasses an area of approximately 1.4 acres, is generally flat, and is covered by areas of grass, gravel, concrete, and asphalt pavement. The site is located in a predominantly commercial area with some single-family residences located to the southeast and northwest. The southern part of the site (adjacent to the Intracoastal Waterway) is currently utilized by the public as a shoreline fishing and crabbing area. A generalized site plan depicting site features is included as Figure 2 (Appendix A).

2.2 Site History

Based on information provided by the Corps, the site has been a grass and gravel covered parcel accessible to the public for shoreline fishing and crabbing since the late 1940s. Prior to that, a bridge was located on the western portion of the site. The bridge and associated bulkhead were replaced in the early 1940s. The location of the bridge and bulkhead has not changed since that time.

According to Corps personnel and documents, petroleum USTs and aboveground storage tanks (ASTs) are known to have been located on and in the vicinity of the site. USTs were utilized by three former service stations, one of which was located on the site, one east of the site, and one north of the site. The approximate locations of the former stations are depicted on Figure 2 (Appendix A). ASTs are currently and were formerly utilized by many of the single-family residences in the vicinity of the site.

In the 1930s, a Standard service station was located immediately east of the site, in the approximate location of the abandoned single-family residences. No records were available pertaining to the dates of the Standard station operation, number, sizes, or contents of station USTs, and tank closure activities. In the 1950s, an Esso service station was located north of the site, on the northern side of Watson Road. No records were available pertaining to the dates of the Esso station operation, number, sizes, or contents of station USTs, and tank closure activities. Several groundwater monitoring wells were identified on this property during a visual inspection by a Versar geologist in August 1995. Corps personnel are currently researching DEQ records for information pertaining to these sites.

In the 1950s, a service station, named Meads Cafe and Gas Station, was located on the site, adjacent to the two concrete slabs located near the northern corner of the commercial stores and single-family residences building. The station may have operated as early as the 1930s and 1940s. Based on DEQ records, two 550-gallon gasoline USTs utilized by the station were removed from this site in May 1990 by PetroChem Recovery Services, Inc., of Norfolk, Virginia. Based on the analytical results of soil samples collected after tank removal activities were completed, the DEQ, in a letter dated May 21, 1990, granted tank closure and required that no additional environmental activities be performed at the site.

In May 1995, petroleum-impacted soils were noted in the shallow subsurface (upper 10 feet) while drilling geotechnical borings on the site for the Great Bridge Bridge Replacement Feasibility Study (RFS). According to available DEQ records and Corps studies, there have been no documented releases of petroleum hydrocarbons at the site or within the immediate site vicinity. It is possible that small quantities of petroleum may have been released to the site surface from parked vehicles or as a result of unauthorized vehicle oil changes; however, no evidence of surficial spills was noted during the field activities.

2.3 Topography and Drainage

According to the United States Geological Survey (USGS) 7.5-minute series Fentress, Virginia, Quadrangle Topographic Map, dated 1968, (Figure 1, Appendix A), the site lies approximately 5 feet above mean sea level (msl). The topography at and in the vicinity of the site is relatively flat. The site is covered by areas of grass, gravel, concrete, and asphalt pavement. The nearest surface water body, the Intracoastal Waterway, borders the site to the south. Stormwater runoff from the site is conveyed along Battlefield Boulevard located on the western property boundary. The stormwater is eventually conveyed into a drainage system that discharges into the Intracoastal Waterway.

2.4 Geology and Hydrogeology

The site is located within the Coastal Plain physiographic province, which is generally composed of unconsolidated marine sediments that thicken and gently dip eastward. According to the Geologic Map and Cross Sections of the Coastal Plain and Adjacent Parts of the Piedmont, Virginia (Mixon, et al., 1989), the site is underlain by Upper Pleistocene Age interbedded pebbly, sand, silt, and clay deposits of the Sedgefield Member of the Tabb Formation. These sediments are believed to be surficial deposits of riverine, estuarine, and coastal terraces and plains origin, deposited during interglacial high stands of the sea. In addition, many areas of the site may contain imported fill associated with bridge, bulkhead, and Intracoastal Waterway construction activities.

Based on observations made during drilling activities, the subsurface sediments encountered beneath the site consisted of interbedded and mixtures of fill, fine to coarse sand, silt, and clay to a maximum depth of 15 feet below existing grade (beg). Organic matter, shell fragments, and wood were also encountered during drilling activities. These unconsolidated sediments correlate with descriptions of the Sedgefield Member of the Tabb Formation. Many of the investigated areas are believed to have contained fill associated with bridge, bulkhead, and Intracoastal Waterway construction activities. Lithologic logs for these soil test borings are contained in Appendix C.

Groundwater is encountered beneath the site at depths ranging from approximately 3.49 to 5.12 feet beg. Based on monitoring data, inferred groundwater flow beneath the site is in a southerly direction, toward the Intracoastal Waterway. Based on the proximity of the Intracoastal Waterway, the shallow groundwater beneath the site may be subject to tidal influence; however, the tidal influence is believed to be minimal due to the presence of a waterway lock approximately 2,500 feet upstream, to the west.

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3.0 SUMMARY OF INVESTIGATIVE ACTIVITIES

In May 1995, four geotechnical soil test borings were drilled at the site as part of the proposed bridge RFS. A petroleum odor was noted in three of the test borings. Based on the discovery of petroleum-impacted soil, a subsurface investigation was performed by Versar to delineate petroleum-impacted soil and groundwater at the site. The subsurface investigation consisted of drilling twenty-three soil test borings, installing five groundwater monitoring wells, and collecting soil and groundwater samples for field and laboratory analysis, and conducting a magnetic and metal detector survey in areas suspected of containing USTs. The details of the subsurface investigation are summarized in the following sections.

3.1 Soil Test Boring Drilling

In May 1995, four geotechnical soil test borings (designated 94DH-3, 94DH-7, 94DH-8, and 94DH-9) were drilled by McCallum Testing Laboratories, Inc., under the direction of a Corps engineer. The boring locations are depicted on Figure 3 (Appendix A). The borings were drilled for geotechnical purposes as part of the proposed bridge replacement project. The borings were drilled using a mobile drill rig fitted with hollow stem augers (HSA), to a maximum depth of 20.5 feet beg. Soil samples were collected continuously using split-spoon barrel samplers. A Corps engineer visually interpreted (i.e., texture, color, consistency, etc.) and logged the split-spoon samples. A petroleum odor was noted within the samples collected from 3 to 8 feet beg in borings 94DH-7, 94DH-8, and 94DH-9. Boring logs for these borings are contained within Appendix C.

In August 1995, twenty-three additional soil test borings were drilled (designated SB-1 through SB-18 and MW-1 through MW-5) by Connelly and Associates of Frederick, Maryland, under the direction of a Versar geologist and Corps engineer. The borings were drilled to assess the vertical and horizontal extent of petroleum-impacted soil identified during the bridge RFS (geotechnical borings 92DH-10 and 92DH-16) conducted at the site and in potentially-impacted areas (formerly containing USTs) not investigated at the site. The borings were drilled using a mobile drill rig fitted with HSA, to a maximum depth of 15 feet beg. Soil samples were collected approximately every 5 feet using split-spoon barrel samplers. A Versar geologist visually interpreted (i.e., texture, color, consistency, etc.) and logged the split-spoon samples. The soil boring locations are depicted on Figure 3 (Appendix A). Boring logs are contained within Appendix C.

The soil cuttings generated during the last drilling event were contained in 55-gallon sealed drums and transported off site for disposal by a Commonwealth of Virginia and Corps certified waste hauler.

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3.2 Groundwater Monitoring Well Installation

Five of the soil test borings drilled by Connelly in August 1995 were completed as groundwater monitoring wells (designated MW-1 through MW-5). The locations of the monitoring wells are depicted on Figure 3 (Appendix A). The wells were installed to a maximum depth of 15 feet beg and constructed of 2-inch inner-diameter (ID) polyvinyl chloride (PVC) threaded casing and 12 feet of 0.010-slot screen. Sand pack was placed around each screen to a level approximately 1 foot above the top of the screened interval. A 2-foot thick bentonite seal was placed above the sand pack. The remaining annular space was filled with a cement-bentonite grout to grade. Each well was completed with a bolt-down flush-mount manhole cover and a locking well cap. The top of casing of each well was surveyed to a common reference elevation (using a 10-foot benchmark) by Versar in November 1995.

After installation, the wells were developed using dedicated disposable PVC bailers. All purge water generated from development activities was contained in 55-gallon sealed drums and properly disposed of by a Commonwealth of Virginia and Corps certified waste hauler.

3.3 Soil Sampling

During soil test boring drilling and monitoring well installation in August 1995, split-spoon soil samples were collected at the soil/groundwater interface. One part of each sample was prepared for field screening by filling a Ziploc-type bag half full, sealing the bag, and allowing the sample to equilibrate for 15 minutes. The other half of each sample split was prepared for potential laboratory analysis by tightly packing the soil sample into a pre-cleaned 2-ounce jar, closing the jar with a Teflon®-lined cap, and placing the jar in an ice-filled cooler.

The soil sample selected for field analysis was screened using a photoionization detector (PID) for the potential presence of volatile organic compounds (VOCs) associated with petroleum hydrocarbons. The ten soil samples selected for laboratory analysis were submitted to EA Laboratories of Sparks, Maryland, for analysis of benzene, toluene, ethylbenzene, and xylenes (BTEX), naphthalene, and methyl tertbutyl ether (MTBE) using EPA Method 8020, diesel and gasoline range total petroleum hydrocarbons (TPH) using EPA Method 8015 modified, and lead using EPA Method 6010.

3.4 Groundwater Measurement

Groundwater level measurements were collected before sampling the site wells on September 7 and November 10, 1995. The depth to water was measured in each of the site monitoring wells using an audible electronic oil/water interface probe decontaminated between individual well measurements to minimize the potential for cross-contamination. Free-phase hydrocarbons (FPH) were not detected in any of the monitoring wells during either of the sampling events. The groundwater measurement data are summarized in Table 1 (Appendix B).

3.5 Groundwater Sampling

The five site groundwater monitoring wells (MW-1 through MW-5) were sampled on September 7 and November 10, 1995, by Versar. Before collecting the samples, the depth-to-product (FPH), if encountered, depth-to-water, and total well depth in each of the monitoring wells were measured using an audible electronic oil/water interface probe. Each well was then purged of a minimum of three boring volumes of groundwater using disposable dedicated PVC bailers. Samples were collected from each well using the dedicated bailers, transferred to laboratory-grade sample containers, and submitted to EA Laboratories. The samples were analyzed for BTEX, naphthalene, and MTBE using EPA Method 8020, diesel and gasoline range TPH using EPA Method 8015 modified, and lead using EPA Method 6010.

All purge water generated during the sampling activities was contained in 55-gallon sealed drums and was properly disposed of by a Commonwealth of Virginia and Corps certified waste hauler.

3.6 Magnetic and Metal Detector Survey

A magnetic and metal detector survey was conducted in August 1995 by Versar in the area formerly occupied by Meads Cafe and Gas Station, which was formerly located on the site (Figure 2, Appendix A). The survey was conducted using both an electronic magnetic detector and metal detector in an effort to locate any USTs potentially located in the shallow subsurface (upper 5 feet).

4.0 RESULTS OF INVESTIGATIVE ACTIVITIES

4.1 Soil Quality

VOCs associated with petroleum hydrocarbons were detected in several of the field samples collected during the drilling activities in August 1995. PID headspace readings ranged from 1 part per million (ppm) in samples collected from borings SB-4, SB-6, and SB-8 to 80 ppm in the sample collected from boring SB-13 at a depth of 5 to 7 feet beg. The PID headspace readings are summarized on the boring logs included in Appendix C. Based on the PID readings and field observations, ten soil samples were submitted for analysis of BTEX, naphthalene, and MTBE using EPA Method 8020, diesel and gasoline range TPH using EPA Method 8015 modified, and lead using EPA Method 6010.

MTBE, benzene, and naphthalene were not detected in any of the soil samples submitted for laboratory analysis. Toluene was detected in the samples collected from borings SB-4 (5 to 7 feet beg), SB-13 (5 to 7 feet beg), and MW-5 (4 to 6 feet beg) at concentrations of 1.3 parts per billion (ppb), 9.4 ppb, and 1.3 ppb, respectively. Ethylbenzene was detected in the samples collected from borings SB-4 (5 to 7 feet beg) and SB-13 (5 to 7 feet beg) at concentrations of 3.4 ppb and 12 ppb, respectively. Total xylenes were detected in the samples collected from borings SB-4 (5 to 7 feet beg), SB-11 (5 to 7 feet beg), SB-13 (5 to 7 feet beg), and MW-5 (4 to 6 feet beg) at concentrations of 20.7 ppb, 1.7 ppb, 8.8 ppb, and 2.9 ppb, respectively. Diesel range TPH were detected in the samples collected from borings SB-4 (5 to 7 feet beg) and SB-6 (5 to 7 feet beg) at concentrations of 600 ppm and 110 ppm, respectively. Gasoline range TPH were detected in seven of the submitted samples, and ranged from 0.15 ppm in sample SB-9 (5 to 7 feet beg) to 54 ppm in sample SB-13 (5 to 7 feet beg). Lead concentrations ranged from 1.3 ppm in sample MW-5 (4 to 6 feet beg) to 19.9 ppm in sample SB-9 (5 to 7 feet beg). The soil sample results are summarized in Table 2 (Appendix B) and are depicted in Figure 4 (Appendix A). The laboratory results and associated chain of custody forms are included in Appendix D.

Based on the soil sampling results, diesel range TPH are present in soils at the site above the DEQ action guidance level of 100 ppm for TPH-impacted soils. BTEX constituents were not detected above the EPA-Risk Based Concentration Table (EPA-RBCT) concentrations for residential soils (January 1995). The concentrations of lead detected in the samples are within the expected range for soils located in southeastern Virginia (USGS, 1984). The highest degree of petroleum impact to site soils appears to have occurred at the soil/water interface (an approximate depth of 5 feet beg) on the southern part of the site (diesel range petroleum) and in the vicinity of the former Meads Cafe and Gas station. The probable source of petroleum contamination identified on the southern part of the site is believed to be the former Standard service station and/or former residential USTs or ASTs.

4.2 Groundwater Quality

The five site groundwater monitoring wells were sampled in September and November 1995. FPH were not detected in any of the site wells during either of the groundwater sampling events. The samples were analyzed for BTEX, naphthalene, and MTBE using EPA Method 8020, diesel and gasoline range TPH using EPA Method 8015 modified, and lead using EPA Method 6010. MTBE was not detected in any of the groundwater samples collected during either of the sampling events. Also, BTEX, naphthalene, and TPH were not detected in groundwater samples collected from wells MW-1 and MW-3 during either of the sampling events.

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BTEX constituents, naphthalene, diesel and gasoline range TPH, and lead were detected in wells MW-2, MW-4, and MW-5 during the September 1995 sampling event. Benzene was detected in wells MW-2, MW-4, and MW-5 at concentrations of 20 ppb, 1.8 ppb, and 4 ppb, respectively. Toluene was detected at a concentration of 3.5 ppb in wells MW-2 and MW-5. Ethylbenzene was detected in wells MW-4 and MW-5 at concentrations of 4.5 ppb and 3.5 ppb, respectively. Total xylenes were detected in wells MW-2, MW-4, and MW-5 at concentrations of 6.3 ppb, 1.1 ppb, and 9 ppb, respectively. Naphthalene was detected in wells MW-4 and MW-5 at concentrations of 5.7 ppb and 7.4 ppb, respectively. Diesel range TPH were detected in well MW-2 at a concentration of 0.71 ppm. Gasoline range TPH were detected in wells MW-2 and MW-4 at concentrations of 0.35 ppm and 0.33 ppm, respectively. Lead was detected in all of the samples, and ranged from in concentration from 5 ppb in well MW-5 to 38.5 ppb in well MW-2. Contaminant concentration maps for the September 1995 sampling event are included as Figures 5 through 7 (Appendix A). The laboratory results and associated chain of custody forms are included in Appendix E.

BTEX constituents and diesel and gasoline range TPH were detected in wells MW-2, MW-4, and MW-5 during the November 1995 sampling event. Benzene was detected in wells MW-2, MW-4, and MW-5 at concentrations of 11 ppb, 2.7 ppb, 2.2 ppb, respectively. Toluene was detected in wells MW-2, MW-4, and MW-5 at concentrations of 3.5 ppb, 1 ppb, and 1.7 ppb, respectively. Ethylbenzene was detected in wells MW-4 and MW-5 at concentrations of 7.1 ppb and 1.2 ppb, respectively. Total xylenes were detected in wells MW-2 and MW-5 at concentrations of 7 ppb and 3.1 ppb, respectively. Naphthalene was not detected in any of the wells sampled. Diesel range TPH were detected in wells MW-2 and MW-4 at concentrations of 0.74 ppm and 0.51 ppm, respectively. Gasoline range TPH were detected in wells MW-2, MW-4, and MW-5 at concentrations of 0.25 ppm, 1.1 ppm, and 0.17 ppm, respectively. Contaminant concentration maps for the September 1995 sampling event are included as Figures 7 through 10 (Appendix A). The laboratory results and associated chain of custody forms are included in Appendix E.

Benzene was the only BTEX constituent detected during both sampling events (in well MW-2 only) above the DEQ action guidance level of 5 ppb for tap water. TPH were detected above the DEQ action guidance level of 1 ppm for TPH-impacted groundwater in well MW-4 during the November 1995 sampling event. Based on the groundwater analytical results, the highest degree of petroleum impact to site groundwater has occurred on the western perimeter of the site. The probable source of petroleum contamination is believed to be the former Meads Cafe and Gas station USTs (identified on the northern part of the site) and the former Standard service station and/or former residential USTs or ASTs (potentially located on and to the south of the site.

Table 3
Groundwater Sampling Analytical Results

Great Bridge Bridge-North Approach Site
U.S. Army Corps of Engineers
Chesapeake, Virginia

Well No.	Date	MTBE (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl benzene (ppb)	Total Xylenes (ppb)	Naphthalene (ppb)	Diesel Range TPH (ppm)	Gasoline Range TPH (ppm)	Lead (ppb)
MW-1	9/7/95	ND	ND	ND	ND	ND	ND	ND	ND	10.1
	11/10/95	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-2	9/7/95	ND	20	3.5	ND	6.3	ND	0.71	0.35	38.5
	11/10/95	ND	11	3.5	ND	7	ND	0.74	0.25	ND
MW-3	9/7/95	ND	ND	ND	ND	ND	ND	ND	ND	22.8
	11/10/95	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-4	9/7/95	ND	1.8	ND	4.5	1.1	5.7	ND	0.33	25.7
	11/10/95	ND	2.7	1	7.1	ND	ND	0.51	1.1	ND
MW-5	9/7/95	ND	4	3.5	3.5	9	7.4	ND	ND	5
	11/10/95	ND	2.2	1.7	1.2	3.1	ND	ND	0.17	ND
DEQ Guidance Action Levels		**180**	**5**	**1,000**	**700**	**10,000**	**NE**	**1**	**1**	**NE**

NOTES:
ND = not detected abcve method detection limit.
ppb = parts per billion.
ppm = parts per million.
BTEX Analyzed by EPA Method 8020.
TPH Anayzed by EPA Method 8015 Modified.
NE = not established.

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Table 2
Soil Sampling Analytical Results

Great Bridge Bridge-North Approach Site
U.S. Army Corps of Engineers
Chesapeake, Virginia

Sample No	Date	MTBE (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Total Xylenes (ppb)	Naphthalene (ppb)	Diesel Range TPH (ppm)	Gasoline Range TPH (ppm)	Lead (ppb)
SB4-5-7	8/21/95	ND	ND	1.3	3.4	20.7	ND	600	0.53	19.6
SB6-5-7	8/21/95	ND	ND	ND	ND	ND	ND	110	0.16	12.2
SB9-5-7	8/21/95	ND	ND	ND	ND	ND	ND	ND	0.15	19.9
SB11-5-7	8/22/95	ND	ND	ND	ND	1.7	ND	ND	ND	2.5
SB12-5-7	8/22/95	ND	ND	ND	ND	ND	ND	ND	ND	2.4
SB13-5-7	8/22/95	ND	ND	9.4	12	8.8	ND	ND	54	2.4
SB15-7-9	8/22/95	ND	ND	ND	ND	ND	ND	ND	0.24	1.4
MW2-4-6	8/22/95	ND	ND	ND	ND	ND	ND	ND	0.21	17.2
MW3-4-6	8/23/95	ND	ND	ND	ND	ND	ND	ND	ND	3.2
MW5-4-6	8/23/95	ND	ND	1.3	ND	2.9	ND	ND	0.47	1.3
DEQ Guidance Action Levels		-	-	-	-	-	-	100	100	-

NOTES:
ND = not detected above Method detection limit.
ppb = parts per billion.
ppm = parts per million.
BTEX, MTBE, and Naphthalene Analyzed by EPA Method 8020.
TPH Analyzed by EPA Method 8015 Modified.

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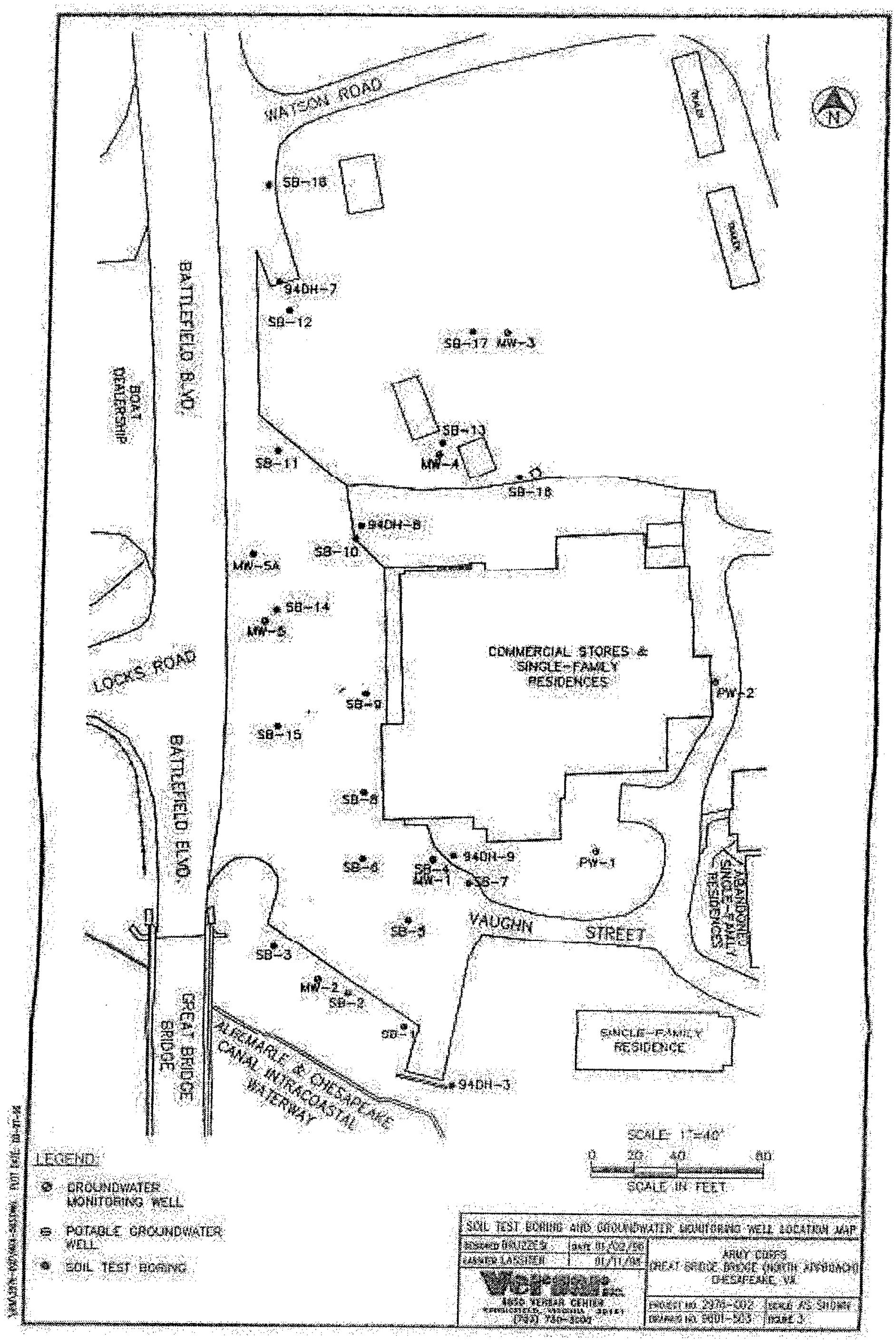

02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL

South Approach

Versar INC

SITE CHARACTERIZATION REPORT
GREAT BRIDGE BRIDGE PROPERTY
CHESAPEAKE, VIRGINIA
PC# 93-0247

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (Corps) retained Versar, Inc., to prepare a Site Characterization Report (SCR) for the Great Bridge Bridge property located in Chesapeake, Virginia. The SCR was prepared in response to a letter from the Commonwealth of Virginia Department of Environmental Quality (DEQ), dated December 6, 1994. A copy of this letter is included as Appendix C. The preparation of a SCR, including a detailed risk assessment, was requested by the DEQ upon their review of a Site Investigation Report (SIR) prepared by the Corps, dated May 26, 1993, and a subsequent meeting attended by Mr. Marc Gutterman and Mr. Steve Melcik of the Corps and Mr. Dave Borton, Mr. Gene Siudyla, Mr. Pat Fly, and Mr. Jay Roberts of the DEQ on December 1, 1994. The SIR summarized the initial investigation activities performed following the discovery of petroleum-impacted soil while drilling archaeological borings for the Great Bridge Bridge Replacement Feasibility Study (RFS). A copy of the SCR is included as Appendix D.

The purpose of this site characterization is to determine the degree of petroleum impact to shallow soils and groundwater from past and recent on-site activities and existing off-site abandoned petroleum underground storage tanks (USTs). The site characterization activities performed include the drilling of eighteen soil test borings, installing three groundwater monitoring wells, collecting soil and groundwater samples for laboratory analysis, aquifer testing, and preparing this SCR, including a site, risk, and remediation assessment. The SCR was prepared in accordance with the DEQ Petroleum Program Manual, dated March 1, 1995.

2.0 SITE ASSESSMENT

2.1 Site Location and Description

The Great Bridge Bridge property (the "site") is located in a flat area adjacent to the Albemarle/Chesapeake Canal (Intercoastal Waterway), near the northeast corner of the intersection of Battlefield Boulevard (Route 168) and southern approach to the Great Bridge bridge in Chesapeake, Virginia (Figure 1, Appendix A). The site encompasses an area of approximately 0.21 acre and is covered by grass and intermittent gravel. No structures are currently present on the site. According to Corps personnel, a small wood structure, referred to as the "oil house" on past site plans, was removed from the site in the late 1940s. The site is bounded to the north and east by the Intercoastal Waterway, to the south by Basin Road, and to the west by the Great Bridge bridge and Battlefield Boulevard (Figure 2, Appendix A). The site is located in a predominantly commercial area with some single-family residences located to the southeast and northwest. The site is currently utilized by the public as a shoreline fishing and crabbing area. A generalized site plan is included as Figure 3 (Appendix A).

2.2 Site History

Based on information provided by the Corps, the site has been a grass and gravel covered parcel accessible to the public for shoreline fishing and crabbing since the late 1940s. Prior to that, a bridge was located on the western portion of the site. The bridge and associated bulkhead were replaced in the late 1940s. The location of the bridge and bulkhead has not changed since that time.

Petroleum-impacted soils were noted while drilling archaeological borings in July 1992 for the bridge RFS. Subsequent investigations, consisting of soil and groundwater sampling, were performed in May 1993 to assess the vertical and horizontal extent of petroleum-impacted soil and groundwater beneath the site.

According to Corps personnel, no petroleum USTs or aboveground storage tanks (ASTs) are known to have been located on the site; however, at least two USTs were identified on a property located approximately 200 feet southwest and hydraulically upgradient of the site. These tanks are currently out of service and, according to DEQ records, have not been in use since 1983. The capacities, construction, stored fluids, and former uses of these tanks are not known. A 100-gallon kerosene AST is located on the north side of the off-site building that borders Basin Road. The tank is constructed of single-walled steel, not fitted with a containment berm, and moderately rusted. The UST and AST locations are depicted on Figure 2 (Appendix A).

As stated previously, according to Corps personnel, a small structure, referred to as the "oil house" on past site plans, was removed from the site during bridge reconstruction activities in the late 1940s. The oil house was used primarily to store tools; there are no records indicating that the structure was used for the storage of petroleum products.

According to DEQ and Corps personnel, there have been no documented releases of petroleum hydrocarbons at the site or within the immediate site vicinity. It is possible that small quantities of petroleum may have been released to the site surface from parked vehicles or as a result of unauthorized vehicle oil changes; however, no evidence of surficial spills was noted during the field activities.

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2.3 Topography and Drainage

According to the United States Geological Survey (USGS) 7.5-minute series Fentress, Virginia, Quadrangle Topographic Map, dated 1954, (Figure 1, Appendix A), the site lies approximately 5 feet above mean sea level (msl). The topography at and in the vicinity of the site is relatively flat. The entire site is covered with either grass or gravel. A portion of the site extending across Basin Road is covered with asphalt. The nearest surface water body, the Intercoastal Waterway, borders the site to the north and east. Stormwater runoff from the site is conveyed along Basin Road located on the southern property boundary. The stormwater is eventually conveyed into a drainage system that discharges into the Intercoastal Waterway.

2.4 Geology and Hydrogeology

The site is located within the Coastal Plain physiographic province, which is generally composed of unconsolidated marine sediments that thicken and gently dip eastward. According to the Geologic Map and Cross Sections of the Coastal Plain and Adjacent Parts of the Piedmont, Virginia (Mixon, 1989), the site is underlain by Upper Pleistocene Age interbedded pebbly, sand, silt, and clay deposits of the Sedgefield Member of the Tabb Formation. These sediments are believed to be surficial deposits of riverine, estuarine, and coastal terraces and plains origin, deposited during interglacial high stands of the sea. In addition, some areas of the site may contain imported fill associated with bridge, bulkhead, and Intercoastal Waterway construction activities.

Based on observations made during previous drilling activities, the subsurface sediments encountered beneath the site consisted of interbedded and mixtures of fill, fine to medium sand, silt, and clay to a maximum depth of 10 feet below existing grade (beg). Organic matter and shell fragments were also encountered during drilling activities. These unconsolidated sediments correlate with descriptions of the Sedgefield Member of the Tabb Formation. Lithologic logs for previously completed soil test borings are contained in the SIR included as Appendix D.

Groundwater is encountered beneath the site at depths ranging from approximately 1.5 to 3.5 feet beg. Based on monitoring data, inferred groundwater flow beneath the site is in a northerly direction, toward the Intercoastal Waterway. Based on the proximity of the Intercoastal Waterway, the shallow groundwater beneath the site may be subject to tidal influence; however, the tidal influence is believed to be minimal due to the presence of a waterway lock approximately 2,500 feet upstream, to the west.

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3.0 SUMMARY OF INVESTIGATIVE ACTIVITIES

In June 1992, three archeological soil test borings were drilled at the site as part of the proposed bridge RFS. A strong petroleum odor was noted in one of the test borings. Based on the discovery of petroleum-impacted soil, a subsurface investigation was performed to delineate petroleum-impacted soil and groundwater at the site. The subsurface investigation consisted of drilling eighteen soil test borings, completing four groundwater hydropunches, installing three groundwater monitoring wells, collecting soil and groundwater samples for field and laboratory analysis, and aquifer testing. The details of the subsurface investigation are summarized in the following sections.

3.1 Soil Test Boring Drilling

In June 1992, three soil test borings (designated 92DH-6, 92DH-7, and 92DH-8) were drilled by McCallum Testing Laboratories, Inc., of Chesapeake, Virginia, under the direction of a Corps engineer. The borings were drilled for archaeological purposes as part of the proposed bridge replacement project. The borings were drilled using a mobile drill rig fitted with hollow stem augers (HSA), to a maximum depth of 10 feet beg. Soil samples were collected continuously using split-spoon barrel samplers. A Corps engineer visually interpreted (i.e., texture, color, consistency, etc.) and logged the split-spoon samples. A strong petroleum odor was noted within the samples collected from 3 to 5 feet beg from boring 92DH-6. The soil boring locations and logs are contained within Appendix E.

In May 1993, eleven additional soil test borings were drilled (designated GB-1 through GB-11) by McCallum Testing Laboratories under the direction of a Corps engineer. The borings were drilled to assess the vertical and horizontal extent of petroleum-impacted soil identified previously during the drilling of three archaeological borings at the site. The borings were drilled using a mobile drill rig fitted with HSA, to a maximum depth of 6 feet beg. Soil samples were collected continuously using split-spoon barrel samplers. A Corps engineer visually interpreted (i.e., texture, color, consistency, etc.) and logged the split-spoon samples. The soil boring locations and summary of drilling activities are contained within the SIR included as Appendix D.

In July 1994, seven additional soil test borings (designated 94GBW-1, 94GBW-2, 94GBW-3, and 94GB-2 through 94GB-5) were drilled by McCallum Testing Laboratories, under the direction of the Corps. The borings were drilled to further assess the vertical and horizontal extent of petroleum-impacted soil identified at the site. The borings were drilled to a maximum depth of 13.4 feet beg. Soil samples were collected continuously using split-spoon barrel samplers. A Corps engineer visually interpreted (i.e., texture, color, consistency, etc.) and logged the split-spoon samples. The soil boring locations are depicted on a map contained within Appendix F.

The soil cuttings generated during the later two drilling events were contained in 55-gallon sealed drums and transported off site for disposal by a Commonwealth of Virginia and Corps certified waste hauler.

3.2 Hydropunch Sampling

During drilling activities in May 1993, a total of four groundwater samples (designated HP-1 through HP-4) were collected from the western portion of the site by McCallum Testing Laboratories using a Hydropunch II system. The hydropunch samples were collected from the shallow water table, at depths of 3 to 5 feet beg. The hydropunch locations and summary of hydropunch activities are contained within the SIR included as Appendix D.

3.3 Groundwater Monitoring Well Installation

Three of the soil test borings drilled by McCallum Testing Laboratories in July 1994 were completed as groundwater monitoring wells (designated 94GBW-1, 94GBW-2, and 94GBW-3). The locations of the monitoring wells are depicted on Figure 3 (Appendix A). The wells were installed to a maximum depth of 13.4 feet beg and constructed of 2-inch inside diameter (ID) polyvinyl chloride (PVC) threaded casing and 10 feet of 0.010-slot screen. Sand pack was placed around each screen to a level approximately 1 foot above the top of the screened interval. A 1-foot thick bentonite seal was placed above the sand pack. The remaining annular space was filled with a cement-bentonite grout to grade. Each well was completed with a bolt-down flush-mount manhole cover and a locking well cap. The top of casing of each well was surveyed to a common reference elevation (using a 10-foot benchmark) by a Corps engineer in September 1994.

Following completion of the monitoring well installation, the wells were developed using dedicated disposable PVC bailers. All purge water generated from development activities was contained in 55-gallon sealed drums and properly disposed of by a Commonwealth of Virginia and Corps certified waste hauler.

3.4 Soil Sampling

During soil test boring drilling and monitoring well installation, split-spoon soil samples were collected continuously until groundwater was encountered. One part of each sample was prepared for field screening by filling a Ziplock bag half full, sealing the bag, and allowing the sample to equilibrate for 15 minutes. The other half of each sample split was prepared for potential laboratory analysis by tightly packing the soil sample into a pre-cleaned 2-ounce jar, closing the jar with a Teflon-lined cap, and placing the jar in an ice-filled cooler.

The soil sample selected for field analysis was screened using a photoionization detector (PID) for the potential presence of volatile organic compounds (VOCs) associated with petroleum hydrocarbons. The soil samples collected during drilling activities in May 1993 were submitted to Versar Laboratories of Springfield, Virginia, for analysis of total petroleum hydrocarbons (TPH) by EPA Method 418.1. Sample GB-1A was also analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8020. Samples collected during the July 1994 drilling activities were submitted to Environmental Testing Services, Inc., of Norfolk, Virginia, for analysis of BTEX, TPH (gasoline, kerosene, diesel, and heavy oil ranges) by EPA Method 8015 modified, and dissolved lead by EPA Method 200.7. Samples 94GB-2, 94GBW-3, and 94GB-7 were additionally analyzed for acid/base neutral extractable compounds (BNAs) by EPA Method 8270.

3.5 Groundwater Measurement

Groundwater level measurements were collected before sampling the site wells on September 14 and 15, 1994, and May 8, 1995. The depth to water was measured in each of the site monitoring wells using an audible electronic oil/water interface probe decontaminated between individual well measurements to minimize the potential for cross-contamination. Free-phase hydrocarbons (FPH) were not detected in any of the monitoring wells during either of the sampling events. Groundwater measurement data are summarized in Table 1 (Appendix B).

3.6 Groundwater Sampling

In May 1993, a total of four groundwater samples were collected during hydropunch activities. The hydropunch groundwater samples were submitted to Versar Laboratories for analysis of TPH by EPA Method 418.1. Hydropunch sample HP-1 was also analyzed for BTEX.

The three site groundwater monitoring wells (94GBW-1, 94GBW-2, and 94GBW-3) were sampled on September 14, 1994, by the Corps and on May 8, 1995, by Versar. Before collecting the samples, the depth-to-product (FPH), if encountered, depth-to-water, and total well depth in each of the monitoring wells were measured using an audible electronic oil/water interface probe. Each well was then purged of a minimum of three boring volumes of groundwater using disposable dedicated PVC bailers. Samples were collected from each well using the dedicated bailers, transferred to laboratory-grade sample containers, and submitted to Environmental Testing Services (September 1994) or EA Laboratories of Sparks, Maryland (May 1995). The September 1994 samples were analyzed for BTEX, TPH (gasoline, kerosene, diesel, and heavy oil ranges) by EPA Method 8015 modified, and dissolved lead by EPA Method 200.7. The sample collected from well 94GBW-2 was additionally analyzed for BNAs. The May 1995 samples were analyzed for BTEX and TPH (gasoline and diesel ranges) by EPA Method 8015 modified.

All purge water generated during the sampling activities was contained in 55-gallon sealed drums and was properly disposed of by a Commonwealth of Virginia and Corps certified waste hauler.

3.7 Aquifer Testing and Analysis

To evaluate the hydraulic conductivity of the shallow water table aquifer, rising and falling head slug tests were conducted on the three site monitoring wells by Versar on May 8, 1995. The following equipment was used to conduct the aquifer testing: a Hermit Model SE 1000C data logger, a pressure transducer, an electronic well water level indicator, a closed volume slug, and a laptop computer. From this information, values for hydraulic conductivity were determined using AQTESOLV aquifer test software. The equipment and field procedures used for the slug test, the data collected, and the methods for data analyses are described in Appendix G.

4.0 RESULTS OF INVESTIGATIVE ACTIVITIES

4.1 Soil Quality

VOCs associated with petroleum hydrocarbons were detected in several of the field samples collected during the drilling activities in May 1993. PID headspace readings ranged from 13 parts per million (ppm) in the sample collected from boring GB-4, at a depth of 1 to 2 feet beg, to 3,400 ppm in samples collected from borings GB-1 and GB-9, at depths of 2 to 4 feet beg. The PID headspace readings are summarized in Table 5.1 in the SIR included as Appendix D. Based on the PID readings and field observations, twenty-nine soil samples were submitted for TPH analysis by EPA Method 418.1. Sample GB-1A was also submitted for BTEX analysis.

TPH were detected in all of the soil samples collected in May 1993. TPH concentrations ranged from 18.8 ppm in boring GB-6 (collected from a depth of 2 to 4 feet beg) to 3,190 ppm in boring GB-3 (collected from a depth of 2 to 4 feet beg). In the sample submitted for BTEX analysis (collected from boring GB-1A), benzene, ethylbenzene, and xylenes were detected at concentrations of 16 parts per billion (ppb), 390 ppb, and 1,200 ppb, respectively. Toluene was not detected in this sample. The laboratory results and associated chain of custody forms are included in the SIR attached as Appendix D.

VOCs associated with petroleum hydrocarbons were detected in several of the field samples collected during the drilling activities in July 1994. PID headspace readings ranged from 15 ppm in the sample collected from boring 94GB-1, at depth of 2 to 4 feet beg, to 3,564 ppm in the sample collected from boring 94GB-2, at a depth of 2 to 4 feet beg. The PID headspace readings are summarized in the Table 1 of Appendix F. Based on the PID readings and field observations, sixteen soil samples were submitted for TPH, gasoline, kerosene, diesel, and heavy oil ranges, analysis by EPA Method 8015 modified. Samples 94GB-7, 94GB-2, and 94GBW-3 were also analyzed for BTEX and BNAs.

TPH, in the gasoline range, were detected in two of the submitted samples, at a maximum concentration of 1,100 ppm in boring 94GB-7 (collected from a depth of 4 to 6 feet beg). TPH, in the kerosene range, were detected in four of the submitted samples, at a maximum concentration of 2,720 ppm in boring 94GB-7 (collected from a depth of 2 to 4 feet beg). TPH, in the diesel range, were detected in two of the submitted samples, at a maximum concentration of 423 ppm in boring 94GB-5 (collected from a depth of 2 to 4 feet beg). TPH, in the heavy oil range, were detected in eight of the submitted samples, at a maximum concentration of 6,031 ppm in boring 94GBW-1 (collected from a depth of 2 to 4 feet beg). Benzene, toluene, ethylbenzene, and total xylenes were detected at maximum concentrations of 6.57 ppm, 35.7 ppm, 68.5 ppm, and 194 ppm, respectively, in sample 94GB-2. The laboratory results and associated chain of custody forms are included in Appendix F.

BNAs were not detected in the soil samples submitted from borings 94GB-2 and 94GB-7; however, the following BNAs were detected in the sample collected from boring 94GBW-3: anthracene (at 730 ppb), dibenzofuran (at 550 ppb), fluoranthene (at 1,100 ppb), fluorene (at 840 ppb), 2-methylnaphthalene (at 1,300 ppb), naphthalene (at 940 ppb), phenanthrene (at 1,900 ppb), and pyrene (at 580 ppb). All of the detected BNAs are associated with petroleum hydrocarbons. The laboratory results and associated chain of custody forms are included in Appendix F.

Lead concentrations ranged from 1.41 ppm in sample 94GB-7 (collected from a depth of 4 to 6 feet beg) to 172 ppm in sample 94GB-2 (collected from a depth of 2 to 4 feet beg). The laboratory results and associated chain of custody forms are included in Appendix H.

Based on the soil sampling results, TPH are present in soils at the site above the DEQ action guidance concentration of 100 ppm for TPH-impacted soils. BTEX and BNA constituents were not detected above the EPA-Risk Based Concentration Table (EPA-RBCT) concentrations for residential soils (January 1995). Based on the soil analytical results, the highest degree of petroleum-impact to site soils has occurred at the soil/water interface (an approximate depth of 2 feet beg) on the southwestern portion of the site. The probable source of petroleum contamination identified in this area is believed to be an undetermined number of abandoned USTs located approximately 200 feet to the southwest and hydraulically upgradient of the site.

4.2 Groundwater Quality

FPH were not detected during hydropunch activities or in any of the site wells during either of the groundwater sampling events. A total of four groundwater samples (HP-1,HP-2, HP-3, and HP-4) were collected during hydropunch activities in May 1993. The hydropunch samples were collected on the western portion of the site near the soil/water interface, at depth of 3 to 5 feet beg. The hydropunch samples were analyzed for TPH (EPA Method 418.1). Sample HP-1A was also analyzed for BTEX.

TPH were detected in all of the hydropunch groundwater samples at concentrations ranging from 2.16 ppm in HP-4 to 58 ppm in HP-3. In sample HP-1A, benzene, toluene, ethylbenzene, and total xylenes were detected at concentrations of 0.5 ppb, 0.73 ppb, 0.27 ppb, and 2.2 ppb, respectively. The laboratory results and associated chain of custody forms are included in the SIR attached as Appendix D.

The three site monitoring wells were sampled in September 1994 and May 1995. The September 1994 samples were analyzed for BTEX, TPH (gasoline, kerosene, diesel, and heavy oil ranges) by EPA Methods 5030 and 8015 modified, and dissolved lead. The sample collected from well 94GBW-2 was also analyzed for BNAs. The May 1995 samples were analyzed for BTEX and TPH (gasoline and diesel ranges) by EPA Method 8015 modified. The groundwater sampling results are summarized in Table 2 of Appendix B. The laboratory results and associated chain of custody forms for the September 1994 sampling event are included in Appendix H and in Appendix I for the May 1995 sampling event.

Benzene, which was detected at a concentration of 0.518 ppb, was the only BTEX constituent detected in well 94GBW-1 during the September 1994 sampling event. BTEX was not detected in the sample collected from well 94GBW-1 during the May 1995 sample event. Benzene was detected in the samples collected from 94GBW-2 at 2,730 ppb in September 1994 and 2,300 ppb in May 1995. Toluene was detected in the samples collected from 94GBW-2 at 251 ppb in September 1994 and 150 ppb in May 1995. Ethylbenzene was detected in the samples collected from 94GBW-2 at 588 ppb in September 1994 and 590 ppb in May 1995. Xylenes were detected in the samples collected from 94GBW-2 at 1,050 ppb in September 1994 and 799 ppb in May 1995. Benzene was detected in the samples collected from 94GBW-3 at 3.23 ppb in September 1994 and 5.2 ppb in May 1995. Toluene was not detected in the sample collected from 94GBW-3 in September 1994 but was detected at a concentration of 3 ppb in May 1995. Ethylbenzene was not detected in either of the samples collected from 94GBW-3. Xylenes were detected in the samples collected from 94GBW-3 at 7.16 ppb in September 1994 and 3.4 ppb in May 1995. A BTEX concentration map based on the May 1995 results is included as Figure 4 (Appendix A).

Only TPH, in the heavy oil range, were detected in well 94GBW-1 at a concentration 1.6 ppm during the September 1994 sampling event. Only TPH, in the diesel range, were detected in this well at a concentration of 1.1 ppm during the May 1995 sampling event. In well 94GBW-2, only TPH, in the gasoline range, were detected at a concentration of 6.8 ppm in September 1994. TPH in the gasoline and diesel ranges were detected in this well at 24 ppm and 4.2 ppm, respectively, during the May 1995 sampling event. TPH were not detected in well 94GBW-3 during the September 1994 sampling event. Only TPH, in the gasoline range, were detected in this well at a concentration of 0.92 ppm during the May 1995 sampling event. TPH concentration maps based on the May 1995 results are included as Figures 5 and 6 in Appendix A.

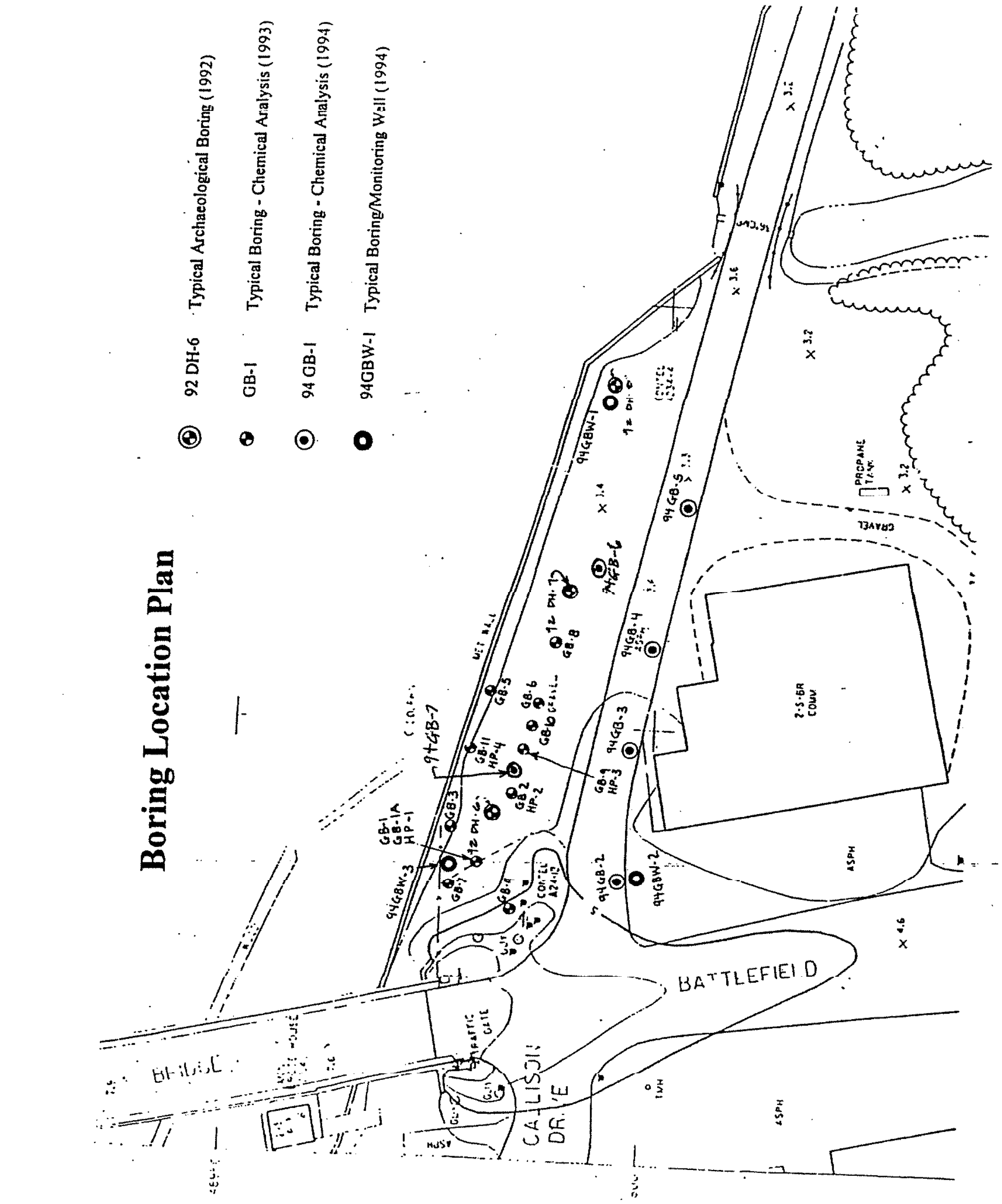
The following BNAs were detected in the sample collected from well 94GBW-2 in September 1994: 2,4-dimethylphenol (at 8.08 ppb), naphthalene (at 30 ppb), and phenol (at 1.65 ppb). One additional BNA was detected in the duplicate sample (labeled 94 GBW-4) collected from this well bis(2-ethylhexyl)phthalate (at 3.51 ppb). All of the detected BNAs, except for bis(2-ethylhexyl)phthalate, are associated with petroleum hydrocarbons. Bis(2-ethylhexyl)phthalate is a commonly found laboratory contaminant and thus, the relatively low concentration of this constituent detected only in the well duplicate sample may be attributed to a laboratory contaminant. The laboratory results and associated chain of custody forms are included in Appendix H.

TPH were detected above the DEQ action guidance concentration of 1 ppm for TPH-impacted groundwater in hydropunch samples and site wells during both sampling events. Benzene was the only BTEX constituent detected (in wells 94GBW-2 and 94GBW-3) above the DEQ and EPA-RBCT concentration of 5 ppb for tap water. Benzene was not detected above the EPA-RBCT concentration in well 94GBW-3 in September 1994, but was detected at a concentration slightly above (5.2 ppb) the DEQ EPA-RBCT concentration during the May 1995 sampling event. None of the BNA constituents detected were above the EPA-RBCT concentrations for drinking water (January 1995). Based on the groundwater analytical results, the highest degree of petroleum-impact to site groundwater has occurred along the southwestern boundary of the site. The probable source area of the petroleum-impacted groundwater is most likely the abandoned USTs located approximately 200 feet to the southwest and hydraulically upgradient of the site.

4.3 Hydraulic Gradient and Conductivity

Based on the September 1994 and May 1995 monitoring data (Table 1, Appendix B), shallow groundwater beneath the site occurs at depths ranging from 1.5 to 3.5 feet beg. Based on an inferred groundwater contour map prepared from the May 1995 monitoring data, groundwater flows in a northerly direction toward the Intercoastal Waterway. The inferred

02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL



02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL

91909	Black / Brown, Fine Texture, No oder Grass Root Ball	91925	Light Gray, Very Sandy texture, No oder No artifacts
91910	Gray/Black / Tan, Fine Texture w/Lumps Strong Hydro oder, No artifacts	91926	Light Gray, Very Sandy material, No oder Large Artifact (Plant material)
91911	Black / Brown, WET, Fine Tex. Strong Hydro Oder, No artifacts	91927	Black color, Fine Texture, Small Roots mild Hydro oder.
91912	Tan, Fine Texture w/ Lumps, Strong Hydro oder, Some Plant material	91928	Tan / Brown, Fine Texture, No oder Some Rocks
91913	Black / Gray / Tan, Fine Texture w/ Lumps Strong Hydro Oder, No artifacts	91929	Black + Gray Color, Fine Texture, mild Hydro Oder, Some Artifacts
91914	Gray / Tan ; Fine Tex. w/Lumps No Oder, No artifacts	91930	Gray Color, Fine Texture w/ Lumps Strong Hydro Oder, Some Rocks
91915	Tan, Fine Tex w/Lumps, No oder Plant material	91931	Gray Color, Fine Texture w/Lumps Strong Hydro oder, Some Artifacts
91916	Black / gray / Tan, Fine Tex. w/Lumps Strong Hydro oder, No Artifacts	91932	Gray, Fine Texture, No oder, No Artifacts
91917	Black / Brown, Fine Tex. w/Lumps, Strong Hydro oder, Plant material	91933	Gray / Black, Fine Texture w/Lump Strong Hydro Oder, No artifacts
91918	Brown, Very Fine Texture, No oder plant material	91934	Black / Light Gray, Fine Texture w Black Lumps + Gray Lumps, No oder, No artifacts
91919	Brown / Tan Layers, No oder, Fine Texture, No artifacts	91935	Black, Fine Texture, No oder, Plant material
91920	Black, Fine texture w/Lumps, Strong Oder, Some Artifacts (Plant material)	91936	Brown / Gray / Black / white Fine Texture w/ white Layers - No oder, No artifacts
91922	Gray / Tan, Fine Texture, mild oder, Plant material	91937	Gray / Brown, Fine texture, Strong Oder No artifacts
91923	Dark Brown, Fine Texture, No oder Plant material	91938	Black, Fine Texture, No oder No artifacts
91924	Black / Gray, Fine Texture w/lumps, no oder Some Rocks		

Versar Laboratories INC.

ANALYSIS REPORT
General Inorganic Chemistry Section

DATE: 24-MAY-93 PAGE: 1
CODE / CONTROL #: NACE / 7793
CLIENT / SITE: NORFOLK ARMY CORPS. / GREATBRIDGE HTW
PROJECT / BATCH: 430.55.0 / 1

Lab#	Field #	TRPH (mg/L)	TRPH (mg/kg)
91905	HP-1	39.5	
91906	HP-2	19.2	
91907	HP-3	58.0	
91908	HP-4	2.16	
91909	GB-1-01		136.
91910	GB-1-02		52.0
91911	GB-1-03		254.
91912	GB-2-01		350.
91913	GB-2-02		2,640.
91914	GB-2-03		262.
91915	GB-3-01		94.6
91916	GB-3-02		3,190.
91917	GB-3-03		279.
91918	GB-4-01		1,090.
91919	GB-4-02		248.
91920	GB-4-03		134.
91922	GB-5-02		25.0
91923	GB-5-03		93.5
91924	GB-6-01		259.
91925	GB-6-02		18.8
91926	GB-6-03		33.6
91927	GB-7-03		183.
91928	GB-8-01		396.
91929	GB-8-03		311.
91930	GB-9-01		640.
91931	GB-9-02		1,670.
91932	GB-9-03		37.7
91933	GB-10-01		193.
91934	GB-10-02		70.0
91935	GB-10-03		86.6
91936	GB-11-01		47.2
91937	GB-11-02		710.
91938	GB-11-03		108.

C Thompson
Laboratory Manager

July 1994

Great Bridge Site Characterization
Soil Sample Analyses Results

Sample #	Depth	PID	RISC	TPH Purgeable	Gas Range Organics	Kerosene Range Organics	Diesel Range Organics	Oil Range Organics	Benzene	Toluene	Ethylbenz	Xylene	Lead	BNA	Comments	Water Table
	feet	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		
94GB-7-04-1	4 to 6	1050	>1000	18.2	25	U	U	64	0.2	0.02	0.125	0.14	9.14	**	Dark Stain/Strong Pet Odor	Below
94GB-7-06-1	4 to 6	1050	>1000	1410	4	U	U	U	0.09	U	0.05	U	1.41	U	QC Sample - ETS Lab	Below
94GB-7-06-1	4 to 6	1050	>1000	ND	1100	ND	60	ND	4.1	ND	12	7.3	90.3	ND	QA Sample - Versar Lab	Below
94GB-2-02-1	2 to 4	3564	>100<1000*	404	U	2400	U	U	6.57	35.7	66.5	194	172	U	Dark Stain/Strong Pet Odor	Above
94GBW-3-02-1	2 to 4	3060	>1000	295	U	284	U	U	U	0.8	1.32	3.27	8.86	U	Dark Stain/Strong Pet Odor	Above
94GB-7-02-1	2 to 4	2890	>1000	101	U	2720	U	252	NA	NA	NA	NA	NA	U	Dark Stain/Strong Pet Odor	Above
94GB-3-02-1	2 to 4	0	>100	U	U	U	U	2	NA	NA	NA	NA	NA	U	No Stain/No Odor	Above
94GB-2-04-1	4 to 6	2950	>1000	48	U	1130	U	U	NA	NA	NA	NA	NA	U	Slight Stain/Slight to Strong Odor	Below
94GB-3-00-1	0 to 2	42	>100<1000	U	U	U	U	742	NA	NA	NA	NA	NA	U	Slight Stain/Slight Odor	Above
94GB-5-02-1	2 to 4	203	<100>1000*	U	U	U	U	358	NA	NA	NA	NA	NA	U	Slight Stain/Slight Odor	Above
94GBW-3-08-1	8 to 10	108	NA	12	12	U	423	148	NA	NA	NA	NA	NA	U	Slight Stain/No Odor	Below
94GBW-3-12-1	12 to 14	201	<100	U	U	U	U	6	NA	NA	NA	NA	NA	U	Slight Stain/No Odor	Below
94GBW-1-02-1	2 to 4	15	NA	U	U	U	U	6031	NA	NA	NA	NA	NA	U	No Stain/No Odor-Highly Organic	Above
94GBW-2-06-1	6 to 8	398	NA	U	U	U	U	U	NA	NA	NA	NA	NA	U	Slight Stain/Strong Odor	Below
94GBW-2-08-1	8 to 10	530	NA	U	U	U	U	U	NA	NA	NA	NA	NA	U	Slight Stain/Slight Odor	Below
94GBW-2-10-1	10 to 12	438	NA	U	U	U	U	123J	NA	NA	NA	NA	NA	U	No Stain/Slight Odor	Below

U - Below Quantitation Limits
J - Suspicious Results
NA - No Test Run
ND - Not Detected
* - RISC Results Suspect
** - 790 ppb Acenaphthylene

Table 2
Groundwater Sampling Analytical Results

Great Bridge Bridge Site
U.S. Army Corps of Engineers
Chesapeake, Virginia
DEQ-PC #93-0247

Well No.	Date	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Total Xylenes (ppb)	Total BTEX (ppb)	TPH as Diesel (ppm)	TPH as Gasoline (ppm)
94GBW-1	9/14/94	0.518	ND	ND	ND	0.518	ND	ND
	5/8/95	ND	ND	ND	ND	ND	1.1	ND
94GBW-2	9/15/94	2,730	251	588	1,050	4,619	ND	6.8
	5/8/95	2,300	150	590	799	3,839	4.2	24
94GBW-3	9/14/94	3.23	ND	ND	7.16	10.39	ND	ND
	5/8/95	5.2	3.0	ND	3.4	11.6	ND	0.92
DEQ Guidance Action Levels		5	1,000	700	10,000	--	1.0	1.0

NOTES:

ND = Not Detected.
ppb = parts per billion.
ppm = parts per million.
BTEX Analyzed by EPA Method 8020.
TPH Analyzed by EPA Method 8015 Modified.

J:\ATLANTIC\WP61\PKL\Bruzzes\Greatbr.tcr(7/14/95 (1:14pm))

GREAT BRIDGE BRIDGE PROJECT-- JUNE 2000 SAMPLING EVENT
ANALYTICAL RESULTS FOR SOILS SAMPLES GBS-1, GBS-2, GBN-1; and SEDIMENT SAMPLES GBSW-S, GBSE-S, GBN-S.

CONSTITUENT	CAS #	GBS-1 BTEX (UG/KG)	FLAG	GBS-2 BTEX (UG/KG)	FLAG	GBN-1 (UG/KG)	FLAG
MTBE	1634-04-4	7	D5, U	1	U	1	U
BENZENE	71-43-2	40	D5	1	U	1	U
TOLUENE	108-88-3	31	D5	1	U	1	U
m&p-XYLENES	108-38-3/106-42-3	60	D5	1	U	1	U
o-XYLENE	95-47-6	220	D5	1	U	1	U
ETHYLBENZENE	100-41-4	130	D5	1	U	1	U

CONSTITUENT	GBS-1 GRO (UG/KG)	FLAG	GBS-2 GRO (UG/KG)	FLAG	GBN-1 (UG/KG)	FLAG
TPH-GRO	350,000		120	U	130	U

CONSTITUENT	GBS-1 DRO (UG/KG)	FLAG	GBS-2 DRO (UG/KG)	FLAG	GBN-1 DRO (UG/KG)	FLAG
TPH-DRO	300,000		38,000		59,000	

CONSTITUENT	CAS #	GBSW-S (MG/KG)	FLAG	GBSE-S (MG/KG)	FLAG	GBN-S (MG/KG)	FLAG
ARSENIC	7440-38-2	3.8		7.2		0.4	B
BARIUM	7440-39-3	23	B	21	B	10.1	B
CADMIUM	7440-43-9	0.1	B	0.23	B	0.11	B
CHROMIUM	7440-47-3	12.1		12.1		5.7	
LEAD	7439-92-1	23.7		27		120	
MERCURY	7439-97-6	0.07	U	0.08	U	0.07	U
SELENIUM	7782-49-2	0.71	BN	0.26	BN	0.2	UN
SILVER	7440-22-4	0.24	U	0.25	U	0.24	U

CONSTITUENT	GBS-1 TOX (MG/KG)	FLAG	GBS-2 TOX (MG/KG)	FLAG	GBN-1 TOX (MG/KG)	FLAG
TOX	31.2	U	26.2	U	26.8	U

CONSTITUENT	GBS-1 BTEX (%)	GBS-2 BTEX (%)	GBN-1 (%)
% MOISTURE	26	18	23

NOTE:

BTEX - BENZENE, TOLUENE, EHTYLBENZENE, AND XYLENES
MTBE - METHYL-TERT-BUTYL ETHER
TPH - TOTAL PETROLEUM HYDROCARBONS
GRO - GASOLINE RANGE ORGANICS
DRO - DIESEL RANGE ORGANICS
TOX - TOTAL ORGANIC HALIDES
RCRA - RESOURCE CONSERVATION AND RECOVERY ACT

UG/KG - MICROGRAMS PER KILOGRAM
MG/KG - MILLIGRAMS PER KILOGRAM

U FLAG - COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
Dx FLAG - COMPOUND CONCENTRATIONS REPORTED FROM A SECONDARY DILUTION, x = DILUTION FACTOR
B FLAG - REPORTED VALUE IS LESS THAN REPORTING LIMIT BUR GREATER THAN INSTRUMENT DETECTION LIMIT
N FLAG - SPIKED SAMPLE RECOVERY IS NOT WITHIN CONTROL LIMITS

GREAT BRIDGE BRIDGE PROJECT- - MAY 2000 SAMPLING EVENT
ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES 94GBW2, 94GBW3, GBMW2.

CONSTITUENT	CAS #	94GBW2-B (UG/L)	FLAG	94GBW3-B (UG/L)	FLAG	GBMW2-B (UG/L)	FLAG	TRIPBLANK (UG/L)	FLAG
BENZENE	71-43-2	2200	D20	62		2		1	U
TOLUENE	108-88-3	110	D20	13		1	U	1	U
ETHYLBENZENE	100-41-4	560	D20	6		1	U	1	U
MTBE	1634-04-4	85	D20	14		1	U	1	U
m&p-XYLENES	108-38-3/106-42-3	480	D20	21		1	U	1	U
o-XYLENE	95-47-6	20	U	4		1	U	1	U

CONSTITUENT	94GBW2-G (UG/L)	FLAG	94GBW3-G (UG/L)	FLAG	GBMW2-G (UG/L)	FLAG
TPH-GRO	14,000		6500	D2	280	

CONSTITUENT	94GBW2-D (UG/L)	FLAG	94GBW3-D (UG/L)	FLAG	GBMW2-D (UG/L)	FLAG
TPH-DRO	4,400		1,500		500	U

NOTE:

BTEX - BENZENE, TOLUENE, EHTYLBENZENE, AND XYLENES
MTBE - METHYL-TERT-BUTYL ETHER
TPH - TOTAL PETROLEUM HYDROCARBONS
GRO - GASOLINE RANGE ORGANICS
DRO - DIESEL RANGE ORGANICS

UG/L - MICROGRAMS PER LITER
MG/L - MILLIGRAMS PER LITER

U FLAG - COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
Dx FLAG - COMPOUND CONCENTRATIONS REPORTED FROM A SECONDARY DILUTION, x = DILUTION FACTOR

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24 Hours: (757) 436-3000
1-800-989-4467
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IMS
ENVIRONMENTAL
SERVICES

PRE-UTILITY INSTALLATION ENVIRONMENTAL INVESTIGATION ADDENDUM

United States Army Corps of Engineers, Norfolk District
Great Bridge Bridge Replacement
South Battlefield Boulevard
Chesapeake, Virginia

IMS Project Number: 351-3278

Submitted To:
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United States Army Corps of Engineers, Norfolk District
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April 26, 2002

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TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

IMS Environmental Services (IMS) was contracted by the United States Army Corps of Engineers (USACE) to perform a subsurface soil and groundwater investigation in the proposed excavation area of a storm sewer extension in Chesapeake, Virginia. Two closed petroleum underground storage tanks (USTs) are known to exist along the route of the sewer extension. This site work is being conducted in conjunction with the Great Bridge bridge replacement over the Intercoastal Waterway. Figure 1 depicts the location and topography of the site.

This report is an addendum to the Pre-Utility Installation Environmental Investigation report, dated March 15, 2002, which was prepared for the USACE by IMS. The text of the March report is included in Appendix A. The investigation in March found no impact on the west side of the existing boulevard on site, but located significant hydrocarbon impact on the east side of Battlefield Boulevard within the proposed construction site. The purpose of this addendum is to further investigate the soil and groundwater on the east side of Battlefield Boulevard.

2.0 BACKGROUND

A Site Characterization Report (SCR), dated August 28, 1995 was prepared for the USACE by Versar, Inc. Versar collected the data for this SCR on May 8, 1995.

A Pre-Utility Installation Environmental Investigation report, dated March 15, 2002, was prepared for the USACE by IMS. IMS collected the data for the investigation on January 10, 2002. The investigation report (text portion in Appendix A) described existing ground water and soil conditions in the vicinity of the proposed construction. The investigation related to hydrocarbon impact on the soil and groundwater at the proposed construction site at the south abutment of the proposed bridge. Sample analysis identified elevated hydrocarbon impact on the east side of Battlefield Boulevard.

3.0 SITE ASSESSMENT PROCEDURES

As part of this investigation, IMS conducted soil and groundwater sampling on April 22, 2002, using a USACE-validated laboratory to analyze the samples. Samples were analyzed for benzene, toluene, ethylbenzene, and total xylene (BTEX), total petroleum hydrocarbons: gasoline-range organics and diesel-range organics (TPH-GRO and -DRO). Samples were collected using a direct push Geoprobe®. The Geoprobe® advanced a hollow tube sampler lined with an acetate sleeve. Soil collected in this sleeve was sampled for analysis. At the termination of the borehole, a stainless steel mesh screen was advanced into the borehole, and a peristaltic pump was used to collect a water sample. Sampling locations focused on the route of a proposed storm sewer extension as illustrated in Figure 2. Results of the soil and groundwater investigations are presented in Section 4.

All samples were numbered with an identifier corresponding to the number of the soil boring. The analytical data from April 22, 2002, sampling was evaluated along with data from the 1995 Versar SCR and the earlier IMS investigation. Figures 3 through 8 depicting soil borings use identifying symbols to differentiate between the borings completed on different dates.

4.0 INVESTIGATION RESULTS

4.1 Soil Sampling Results

As hydrocarbons migrate vertically through the vadose zone and horizontally via groundwater flow, a percentage of the hydrocarbons will become adsorbed to the soil particles. Soil borings to sample adsorbed phase hydrocarbons were collected by the Geoprobe®.

Figure 2 illustrates soil boring locations. Soil borings were collected to a depth of 8 feet. Table 1 describes each soil boring as to the onsite apparent petroleum impact using visual and olfactory methods.

Table 1: Geoprobe® Soil Boring Field Observations

Boring ID	Description of Soil Boring
SB-01	Strong petroleum odor and staining 2 to 6 feet. No analysis requested by USACE technical representative.
SB-02	Faint petroleum odor and staining at 4 to 6 feet. No analysis requested by USACE technical representative.
SB-03	Strong petroleum odor 2 to 6 feet. Saturated gray sand with sheen 4 to six feet. Composite sample analyzed from 2 to 6 feet.
SB-04	Petroleum odor and staining at 2 to 6 feet. Composite sample analyzed from 2 to 6 feet.
SB-05	Sand lens with petroleum odor at 2 feet. Petroleum odor at 4 feet and continuing through core. Composite sample analyzed from 2 to 6 feet.
SB-06	Petroleum odor at 4 feet and continuing through core. Composite sample analyzed from 2 to 6 feet.
SB-07	Layered woody plug in sample at 4 to 16 inches with strong smell. Saturated gray sand with sheen and petroleum odor at 4 feet and continuing through core. Composite sample analyzed from 2 to 6 feet.
SB-08	Saturated gray sand with petroleum odor from 4 to 6 feet. Composite sample analyzed from 2 to 6 feet.
SB-09	No apparent petroleum odor or staining Composite sample analyzed from 2 to 6 feet.

Table 1 (continued)

Boring ID	Description of Soil Boring
SB-10	No apparent petroleum odor or staining No analysis requested by USACE technical representative.
SB-11	No apparent petroleum odor or staining No analysis requested by USACE technical representative.
SB-12	No apparent petroleum odor or staining No analysis requested by USACE technical representative.

Field Work conducted on April 22, 2002

Soil samples from all borings were collected as directed by the USACE technical representative on site and sent to Environmental Science Corporation (ESC) in Mt. Juliet, Tennessee. Analytical results for those samples are summarized in Table 2 with data from previous sampling events; the laboratory report is located in Appendix B. Figures 3, 4, and 5 are site maps illustrating isoconcentrations of dissolved phase BTEX, DRO and GRO in relation to the proposed storm sewer installation.

Table 2: Soil Analytical Results

ID	Parameter	Result	Units	DL	DF
SB-03-05	TPH-DRO (C10-C28)	130	mg/kg	4.9	1
	TPH-GRO (C6-C10)	1700	mg/kg	61.0	500
	Benzene	2.1	mg/kg	0.30	500
	Toluene	BDL	mg/kg	3.0	500
	Ethylbenzene	1.5	mg/kg	0.30	500
	Xylene (total)	2.0	mg/kg	0.91	500
SB-04-05	TPH-DRO (C10-C28)	6.4	mg/kg	5.0	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.62	5
	Benzene	BDL	mg/kg	0.0031	5
	Toluene	BDL	mg/kg	0.031	5
	Ethylbenzene	BDL	mg/kg	0.0031	5
	Xylene (total)	BDL	mg/kg	0.0093	5
SB-05-05	TPH-DRO (C10-C28)	BDL	mg/kg	4.8	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.60	5
	Benzene	BDL	mg/kg	0.0030	5
	Toluene	BDL	mg/kg	0.030	5
	Ethylbenzene	BDL	mg/kg	0.0030	5
	Xylene (total)	BDL	mg/kg	0.0091	5
SB-06-05	TPH-DRO (C10-C28)	BDL	mg/kg	4.9	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.61	5
	Benzene	BDL	mg/kg	0.0030	5
	Toluene	BDL	mg/kg	0.030	5
	Ethylbenzene	BDL	mg/kg	0.0030	5
	Xylene (total)	BDL	mg/kg	0.0091	5

Table 2 (continued)

ID	Parameter	Result	Units	DL	DF
SB-07-05	TPH-DRO (C10-C28)	140	mg/kg	5.0	1
	TPH-GRO (C6-C10)	0.69	mg/kg	0.62	5
	Benzene	BDL	mg/kg	0.0031	5
	Toluene	BDL	mg/kg	0.031	5
	Ethylbenzene	BDL	mg/kg	0.0031	5
	Xylene (total)	BDL	mg/kg	0.0094	5
SB-08-05	TPH-DRO (C10-C28)	BDL	mg/kg	4.9	1
	TPH-GRO (C6-C10)	0.62	mg/kg	0.61	5
	Benzene	BDL	mg/kg	0.0030	5
	Toluene	BDL	mg/kg	0.030	5
	Ethylbenzene	BDL	mg/kg	0.0030	5
	Xylene (total)	BDL	mg/kg	0.0092	5
SB-09-05	TPH-DRO (C10-C28)	14	mg/kg	5.2	1
	TPH-GRO (C6-C10)	1.5	mg/kg	0.65	5
	Benzene	BDL	mg/kg	0.0032	5
	Toluene	BDL	mg/kg	0.032	5
	Ethylbenzene	BDL	mg/kg	0.0032	5
	Xylene (total)	BDL	mg/kg	0.0098	5
SB-6-5* (sample collected January 10, 2002)	TPH-DRO (C10-C28)	1100	mg/kg	47	10
	TPH-GRO (C6-C10)	3400	mg/kg	120	1000
	Benzene	1.8	mg/kg	0.59	1000
	Toluene	BDL	mg/kg	5.9	1000
	Ethylbenzene	23	mg/kg	0.59	1000
	Xylene (total)	34	mg/kg	1.8	1000
94GB-7-04-1* (sample collected May 8, 1995)	TPH-DRO (C10-C28)	BDL	mg/kg	N/A	N/A
	TPH-GRO (C6-C10)	25	mg/kg	N/A	N/A
	Benzene	0.2	mg/kg	N/A	N/A
	Toluene	0.02	mg/kg	N/A	N/A
	Ethylbenzene	0.125	mg/kg	N/A	N/A
	Xylene (total)	0.14	mg/kg	N/A	N/A

DL – Detection Limit; **DF** - Dilution Factor; **BDL** - Below Detection Limit
N/A – Data not available.
*Data collected April 22, 2002 unless otherwise noted.

4.2 Water Sampling Results

Petroleum compounds with high solubilities may dissolve into the groundwater and be transported with groundwater flow. The dissolved hydrocarbons were assessed through groundwater sampling and analysis.

A stainless steel screen was advanced into each borehole to a depth of 10 feet to collect groundwater samples using a peristaltic pump. Groundwater samples were collected April 22, 2002, and shipped to ESC. Analytical results for these samples are summarized in Table 3 with data from previous sampling events; the laboratory report is located in Appendix C. Figures 6, 7, and 8 are site maps illustrating isoconcentrations of BTEX, DRO and GRO in relation to the proposed storm sewer installation.

Table 3: Groundwater Analytical Results

ID	Parameter	Result	Units	DL	DF
WS-03	TPH-DRO (C10-C28)	0.42	mg/l	0.10	1
	TPH-GRO (C6-C10)	0.41	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-04	TPH-DRO (C10-C28)	0.10	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-05	TPH-DRO (C10-C28)	0.16	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-06	TPH-DRO (C10-C28)	0.17	mg/l	0.10	1
	TPH-GRO (C6-C10)	0.24	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-07	TPH-DRO (C10-C28)	1.2	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1

Table 3 (continued)

ID	Parameter	Result	Units	DL	DF
WS-08	TPH-DRO (C10-C28)	0.46	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-09	TPH-DRO (C10-C28)	0.25	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-6 (sample collected January 10, 2002) Former location of 94GBW-2	TPH-DRO (C10-C28)	4.3	mg/l	0.10	1
	TPH-GRO (C6-C10)	12	mg/l	5.0	50
	Benzene	2.6	mg/l	0.025	50
	Toluene	BDL	mg/l	0.25	50
	Ethylbenzene	0.076	mg/l	0.025	50
	Xylene (total)	0.28	mg/l	0.075	50
94GBW-1* (sample collected May 8, 1995)	TPH-DRO (C10-C28)	1.1	mg/l	N/A	N/A
	TPH-GRO (C6-C10)	BDL	mg/l	N/A	N/A
	Benzene	BDL	*ug/l*	N/A	N/A
	Toluene	BDL	*ug/l*	N/A	N/A
	Ethylbenzene	BDL	*ug/l*	N/A	N/A
	Xylene (total)	BDL	*ug/l*	N/A	N/A
94GBW-2* (sample collected May 8, 1995)	TPH-DRO (C10-C28)	4.2	mg/l	N/A	N/A
	TPH-GRO (C6-C10)	24	mg/l	N/A	N/A
	Benzene	2300	*ug/l*	N/A	N/A
	Toluene	150	*ug/l*	N/A	N/A
	Ethylbenzene	590	*ug/l*	N/A	N/A
	Xylene (total)	799	*ug/l*	N/A	N/A
94GBW-3* (sample collected May 8, 1995)	TPH-DRO (C10-C28)	BDL	mg/l	N/A	N/A
	TPH-GRO (C6-C10)	0.92	mg/l	N/A	N/A
	Benzene	5.2	*ug/l*	N/A	N/A
	Toluene	3.0	*ug/l*	N/A	N/A
	Ethylbenzene	ND	*ug/l*	N/A	N/A
	Xylene (total)	3.4	*ug/l*	N/A	N/A

DL – Detection Limit; **DF** - Dilution Factor; **BDL** - Below Detection Limit
N/A – Data not available
*Data collected April 22, 2002 unless otherwise noted.

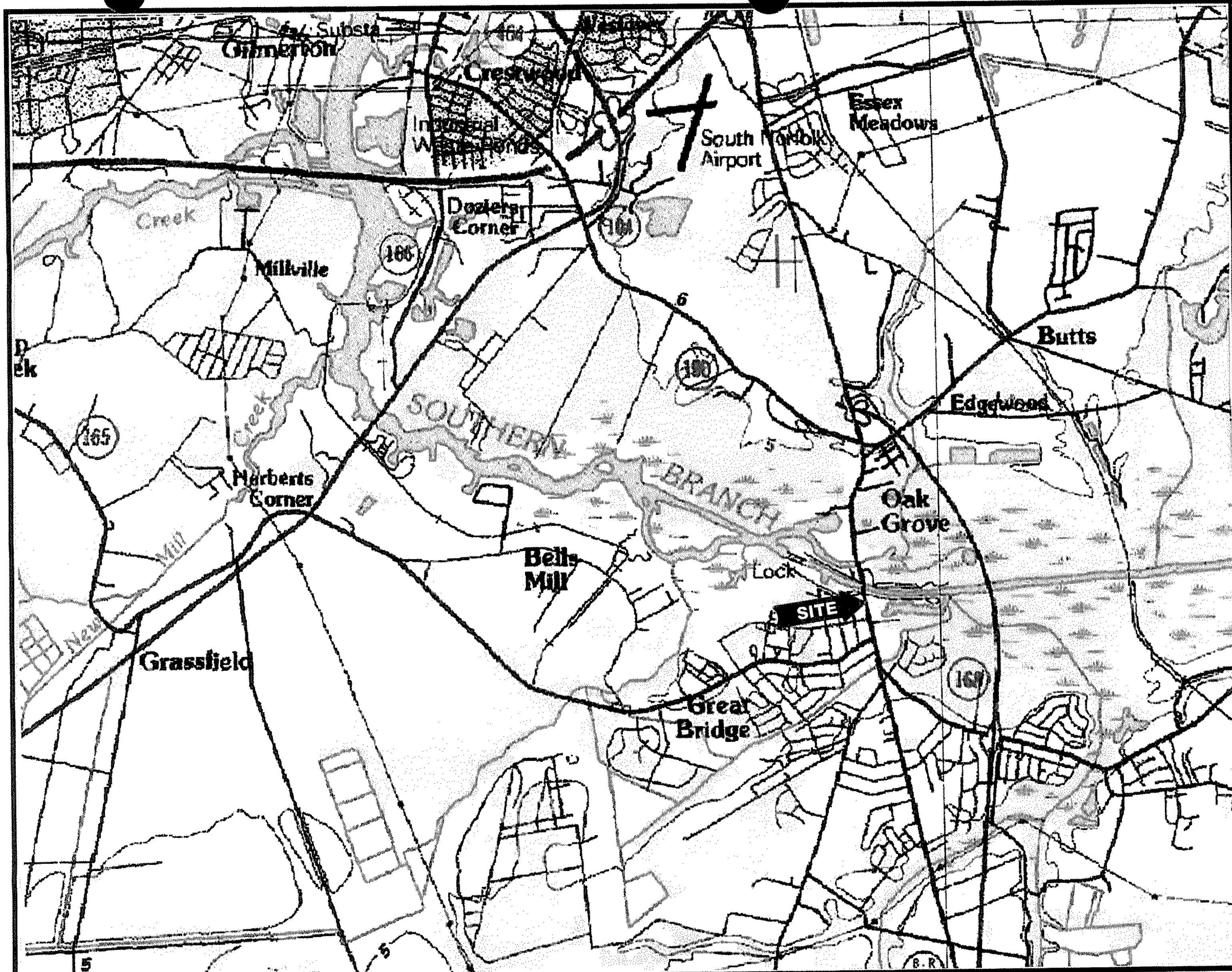
5.0 CONCLUSIONS

Evaluation of the analytic data indicates that a hydrocarbon plume exists on the east side of Battlefield Boulevard. The bulk of the plume exists to the north of the proposed storm sewer traveling along the eastern curb of Battlefield Boulevard. The axis of the plume extends approximately along the west curb of the proposed bridge approach from the south. Samples from SS-6-5, 94GBW-3, SB-03-05 and SB-07-05 in particular show elevated hydrocarbon impact. Excavated soil for the storm sewer in the area bounded by Battlefield Boulevard, the east-west run of the proposed storm sewer, the centerline of the proposed bridge, and the Intercoastal Waterway should be screened during excavation for petroleum impact utilizing a flame ionization detector. Petroleum impacted soil should be segregated, stockpiled, sampled, and recycled or disposed of at an approved disposal/recycling facility.

Possible disposal methods include thermal destruction or landfarming; both of which are available in the Hampton Roads area. Costs for transportation and disposal of soil in the 5 to 10,000 mg/kg range, would be between $55 and $65 per cubic yard, depending on excavation and stockpiling procedures.

If dewatering is required to install the storm sewer section in this area, the removed water will require treatment or disposal. According to VDEQ Guidelines, hydrocarbon impacted water generated by construction activities can be treated and discharged to a grassy area and allowed to infiltrate back into the ground at the discretion and risk of the generator. The water can successfully be treated onsite by air stripping and/or carbon filtration bringing the TPH and BTEX concentrations to non-detectable levels. Field assay test kits or laboratory samples can be utilized to confirm water treatment prior to discharge. Cost for onsite treatment would be between $0.05 and $0.10 per gallon, depending on the flow rate and total volume treated.

FIGURES



Legend: 3222–Topo

Source:
Fentress, Virginia, U.S.G.S. 7.5–minute topographic series, photorevised 1986.

Site Location:
Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

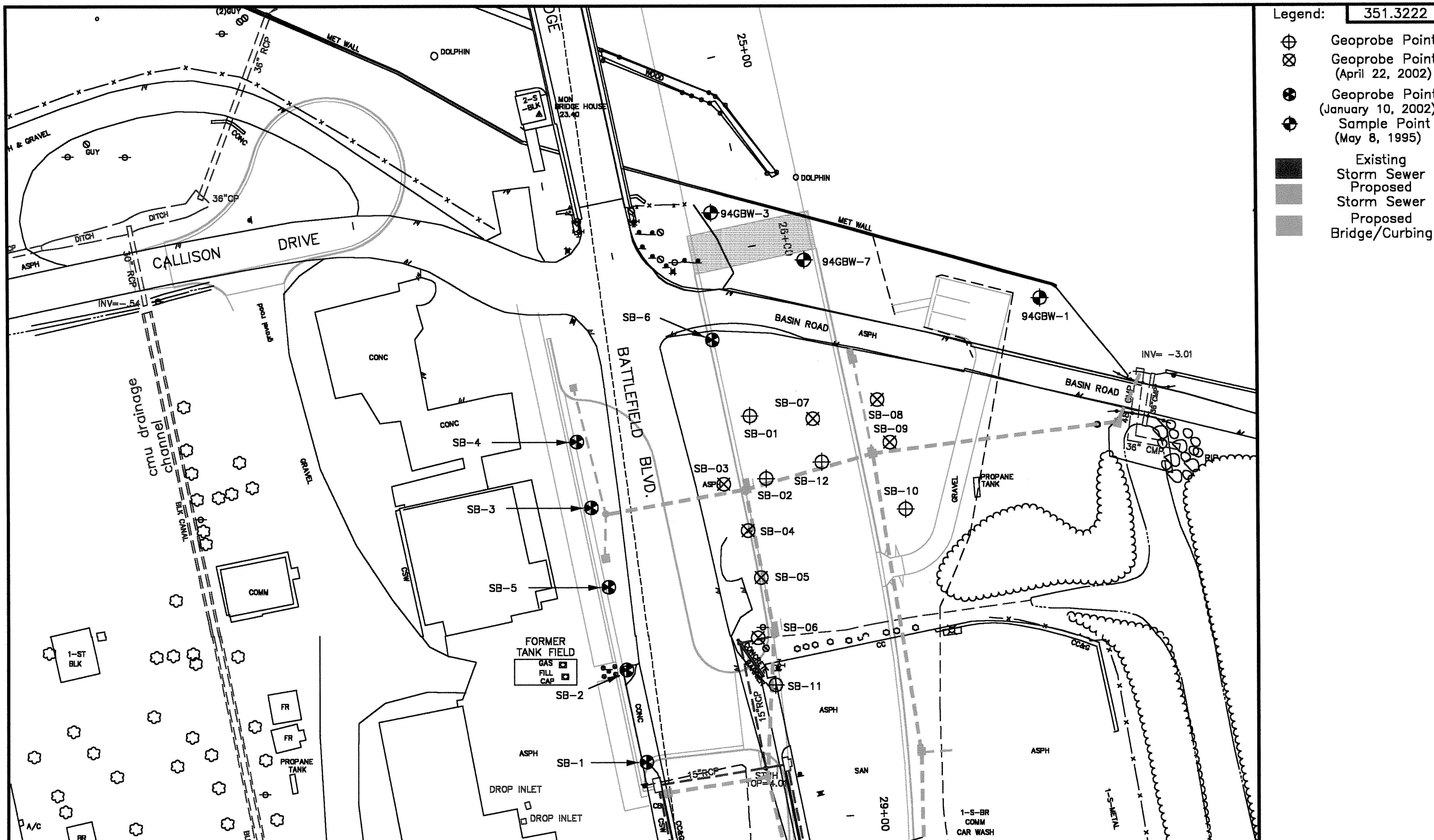
Figure 1: Portion of U.S.G.S. Fentress, Virginia topographic map illustrating the location and topography of the site.

IMS ENVIRONMENTAL SERVICES

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501–1779

Project No: 3222–Topo
Prepared By: CJS
Date: January 14, 2002

Approximate Scale:
1" = 1 Mile



Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
0 10 20 30 40 50
1" = 50'

Figure 2: Site map illustrating locations of Geoprobe soil borings, former tank field, and proposed storm sewer route.

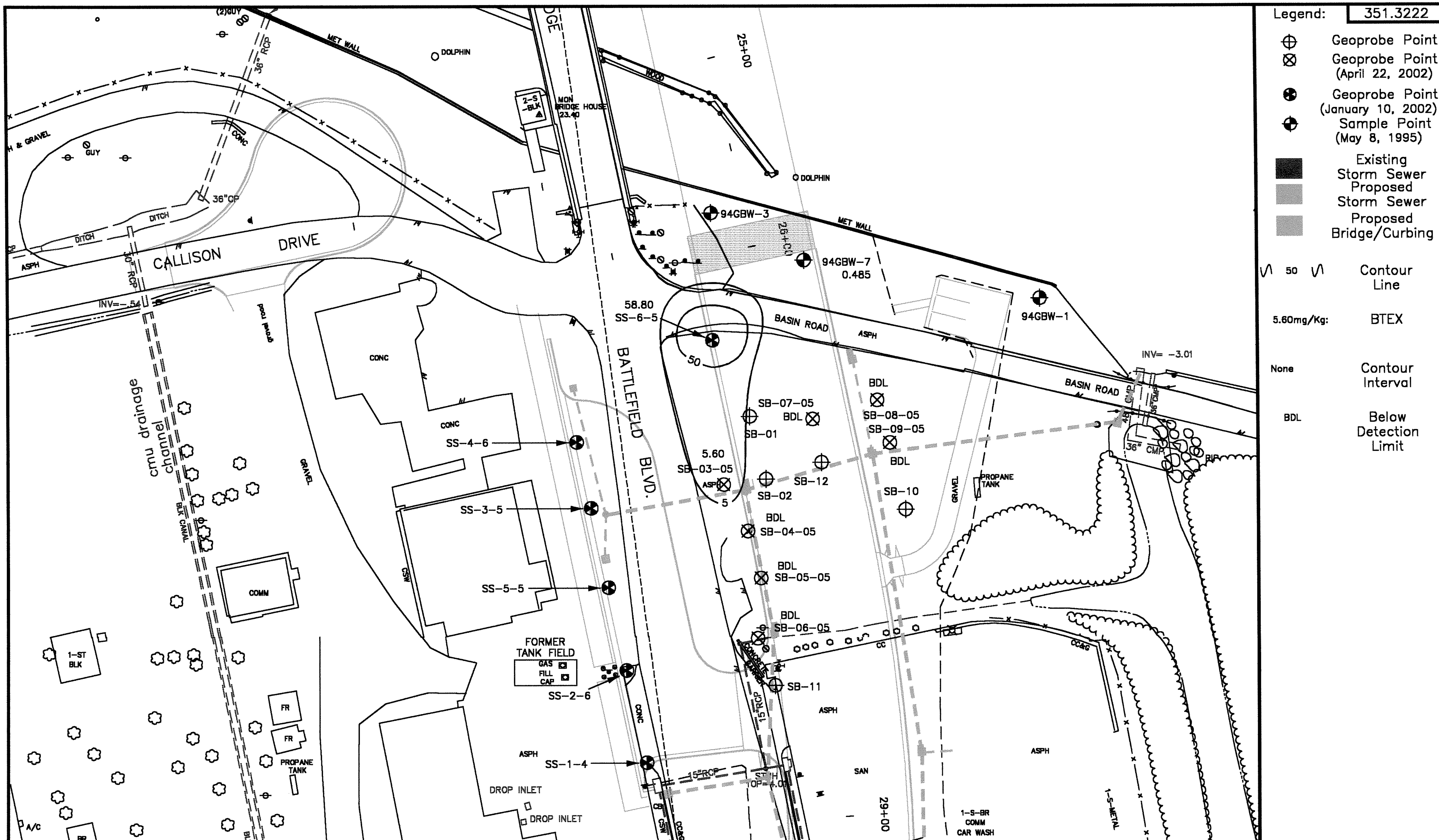


Figure 3: Site map illustrating adsorbed phase (soil) BTEX isoconcentrations.

Site Location:

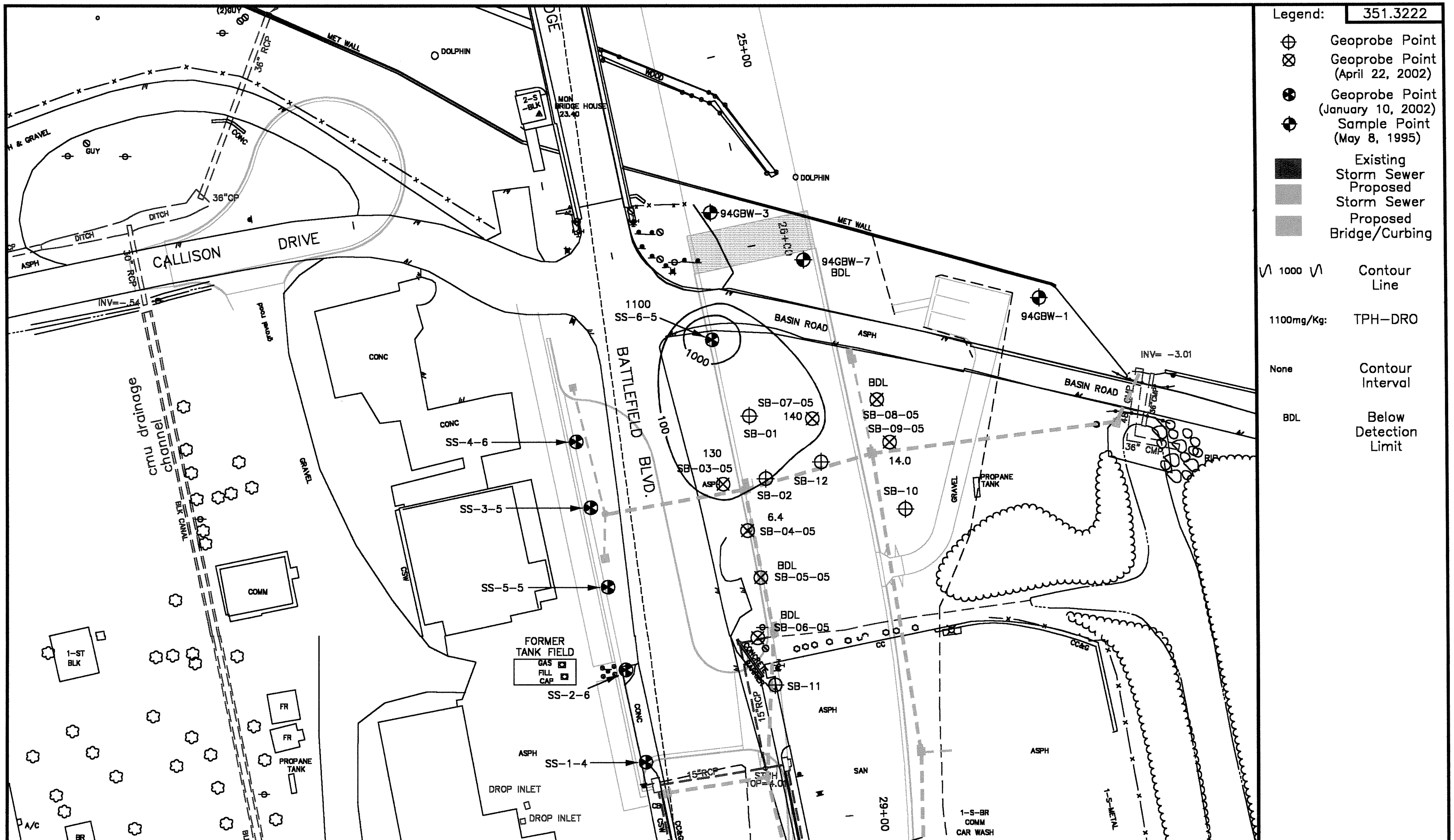
Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
0 10 20 30 40 50
1" = 50'



Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

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Norfolk, Virginia 23501-1779

Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
0 10 20 30 40 50
1" = 50'

Figure 4: Site map illustrating adsorbed phase (soil) TPH-DRO isoconcentrations.

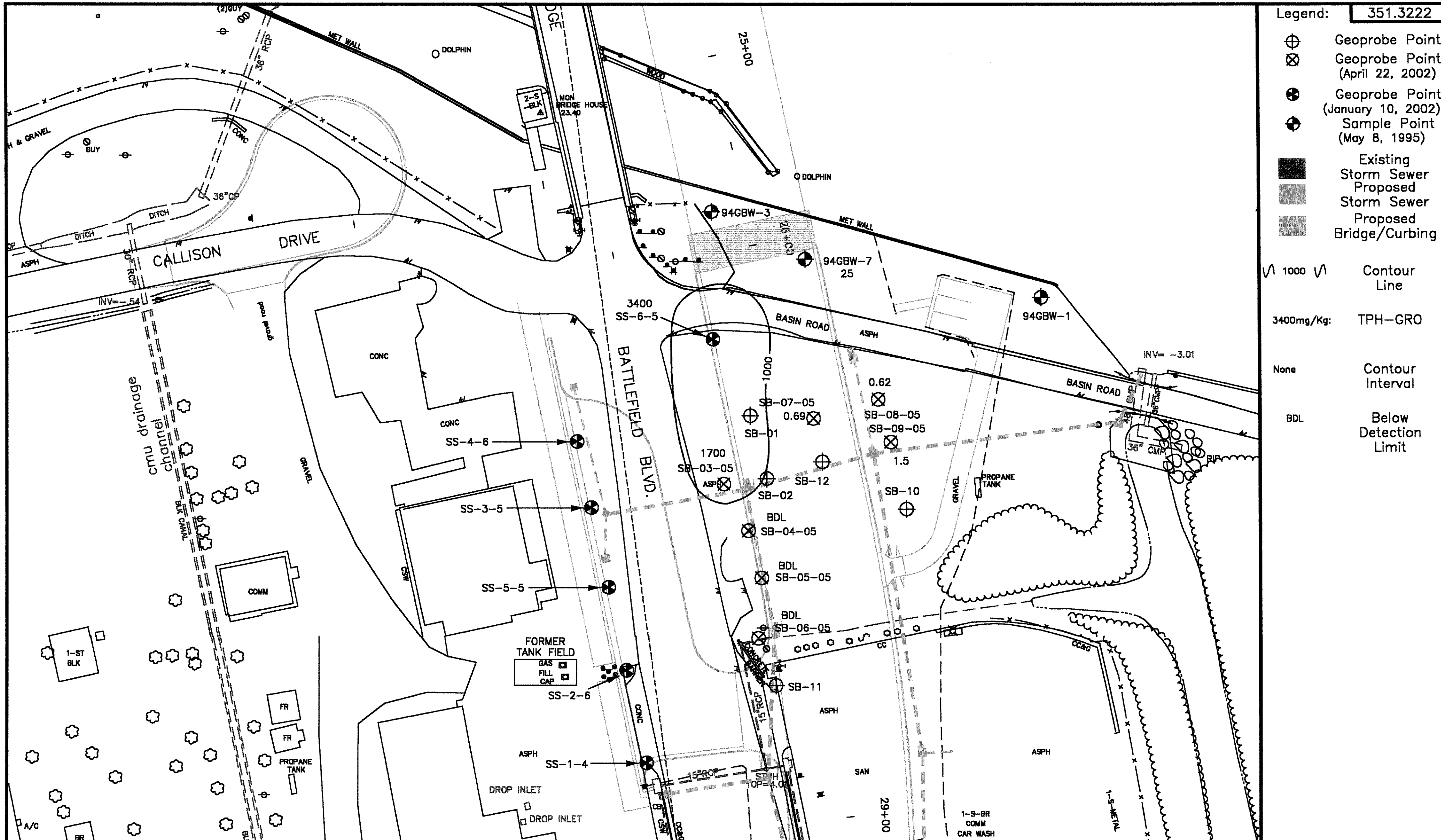

Figure 5: Site map illustrating adsorbed phase (soil) TPH-GRO isoconcentrations.

Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

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Norfolk, Virginia 23501-1779

Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
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1" = 50'

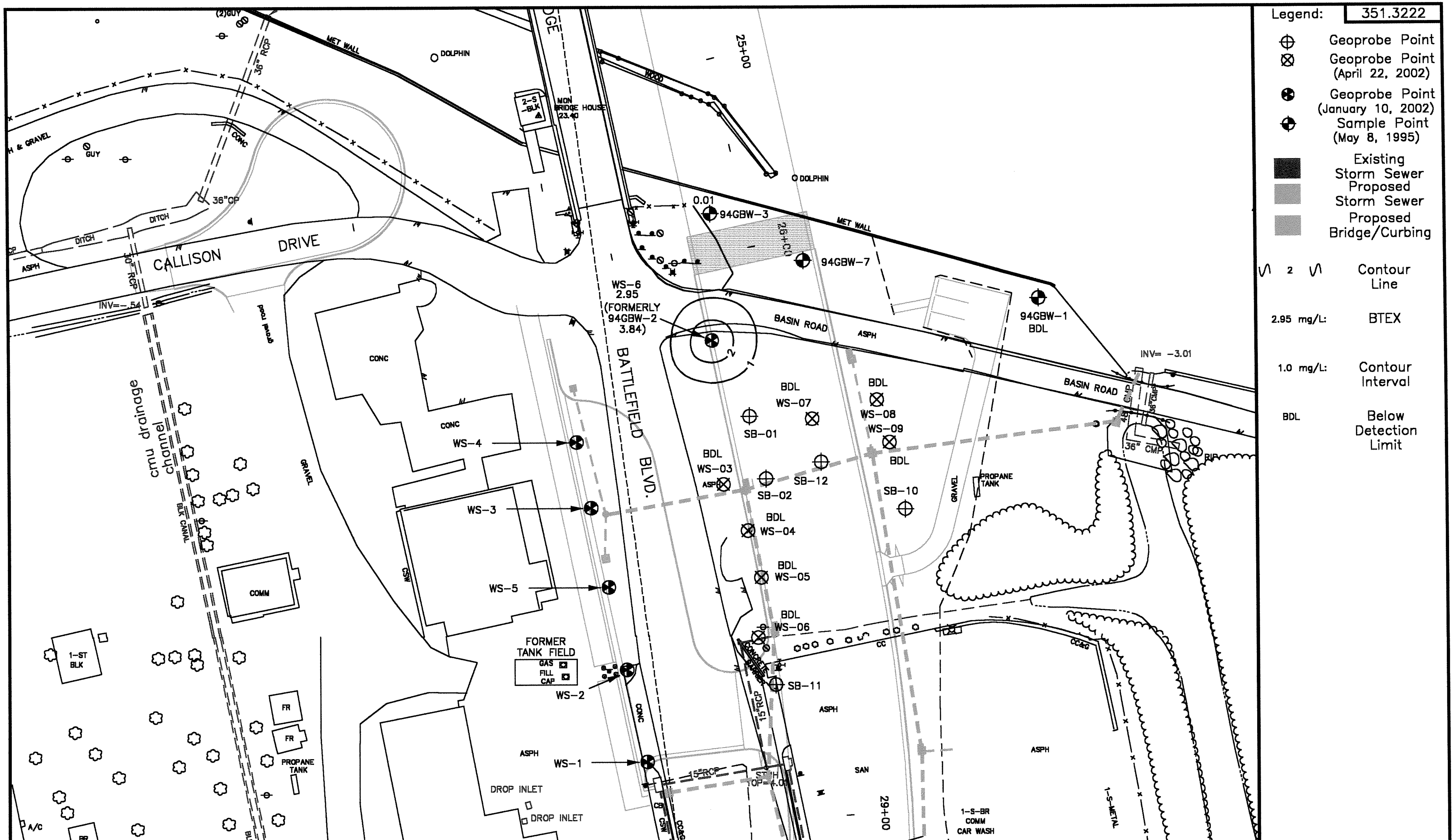

Figure 6: Site map illustrating dissolved phase (water) BTEX isoconcentrations.

Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

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Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
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1" = 50'

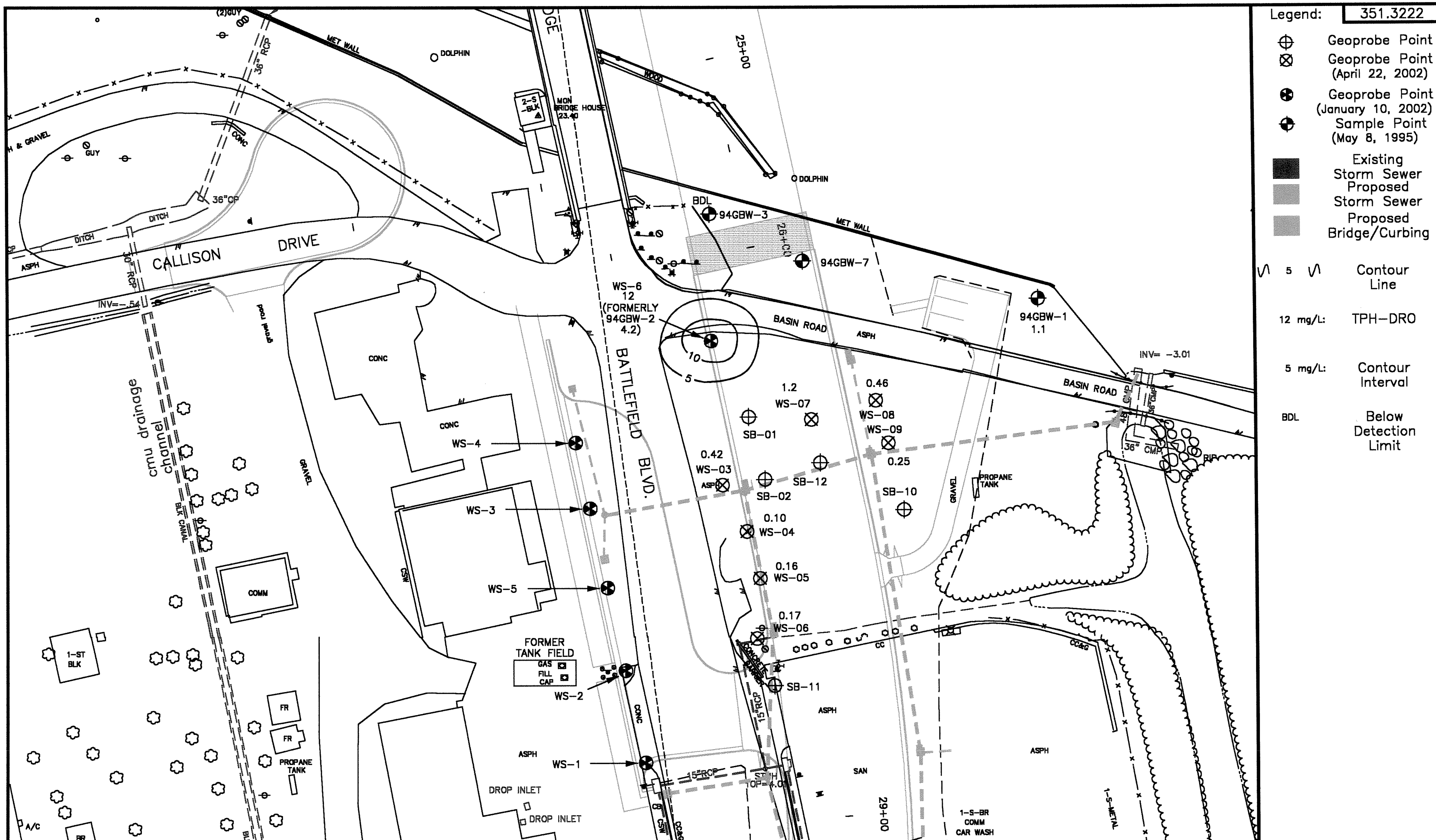

Figure 7: Site map illustrating dissolved phase (water) TPH-DRO isoconcentrations.

Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
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1" = 50'

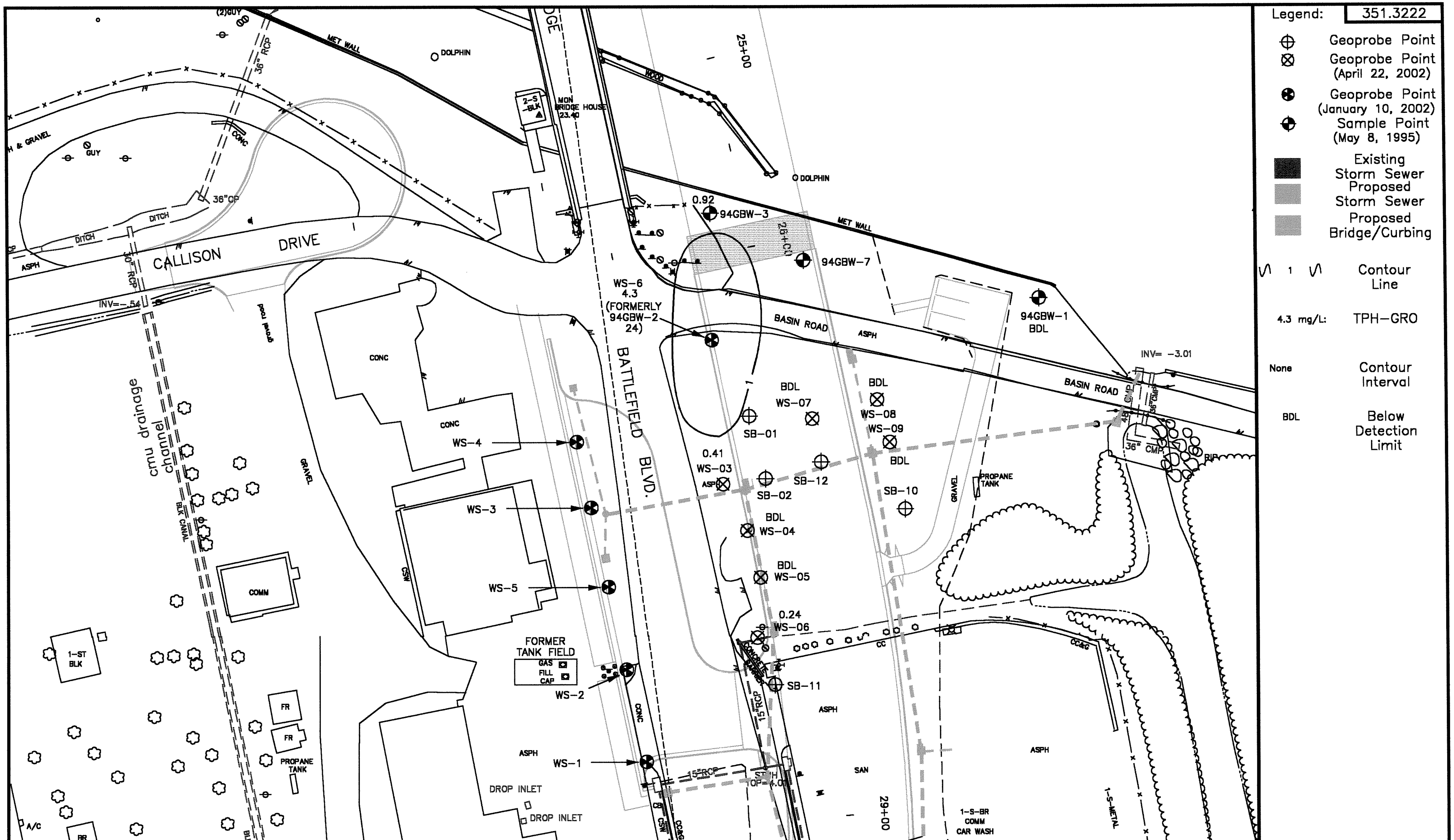

Figure 8: Site map illustrating dissolved phase (water) TPH-GRO isoconcentrations.

Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 351.3222
Prepared By: CJS
Date: July 25, 2002

Approximate Scale:
0 10 20 30 40 50
1" = 50'

APPENDIX A

PRE-UTILITY INSTALLATION ENVIRONMENTAL INVESTIGATION
Dated March 15, 2002
(Text Only)

Mailing Address:P.O.Box 1779
Norfolk, VA 23501-1779
Shipping Address: 929 Professional Place
Chesapeake, VA 23320

24 Hours: (757) 436-3000
1-800-989-4467
Fax: (757) 436-5266

IMS ENVIRONMENTAL SERVICES

PRE-UTILITY INSTALLATION ENVIRONMENTAL INVESTIGATION

United States Army Corps of Engineers, Norfolk District
Great Bridge Bridge Replacement
South Battlefield Boulevard
Chesapeake, Virginia

IMS Project Number: 351-3222

Submitted To:
Mr. Marc Gutterman
United States Army Corps of Engineers, Norfolk District
GeoEnvironmental Branch
803 Front Street
Norfolk, Virginia 23510
(757) 441-7669

<u>Prepared By</u>:
IMS Environmental Services
929 Professional Place
Chesapeake, VA 23320

Prepared By: C. Murray for
Robert Reali, P.E.
Project Manager

Reviewed by: Robert W. May
Robert W. May, P.G.
Senior Geologist

March 15, 2002

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FIGURES

APPENDICES

1.0 INTRODUCTION

IMS Environmental Services (IMS) was contracted by the United States Army Corps of Engineers (USACE) to perform a subsurface soil and groundwater investigation in the proposed excavation area of a storm sewer extension in Chesapeake, Virginia. Two closed petroleum underground storage tanks (USTs) exist along the route of the sewer extension. This site work is being conducted in conjunction with the Great Bridge bridge replacement over the intercoastal waterway (Figures 1 and 2).

2.0 SITE HISTORY

A Site Characterization Report (SCR), dated August 28, 1995 was prepared for the USACE by Versar, Inc. This report identified 2 closed USTs located approximately 200 feet south of the existing bridge. The SCR however was limited to USACE property on the east side of Battlefield Boulevard, approximately 180 feet northwest of the 2 closed USTs (Figure 2). The text of this report is included as Appendix A. Pollution Complaint Number (PC#) 93-0247 was registered with the Virginia Department of Environmental Quality (VDEQ). This PC# was closed by the VDEQ on October 31, 1995, requiring no additional action.

3.0 SITE ASSESSMENT PROCEDURES

As part of this investigation, IMS conducted soil and groundwater sampling, using a USACE validated laboratory. Samples were analyzed for benzene, toluene, ethylbenzene, and total xylene (BTEX), total petroleum hydrocarbons: gasoline-range organics and diesel-range organics (TPH-GRO and -DRO). Samples were collected using a direct push Geoprobe. The Geoprobe advanced a hollow tube sampler lined with an acetate sleeve. Soil collected in this sleeve was collected for the sample. At the termination of the borehole, a stainless steel mesh screen is advanced into the borehole, and a peristaltic pump is used to collect a water sample. Sampling locations focused on the route of a proposed storm sewer extension as illustrated in Figure 2. Results of the soil and groundwater investigations are presented in Section 4.

All samples were numbered as to their site designation, soil boring, and the depth below ground surface that the sample was collected. For example, SS-2-7 represents a soil sample from soil boring location number SB-2 collected at a depth of 7 feet below grade surface. Soil samples were designated as SS. Water samples were designated WS, and were labeled for each soil boring.

4.0 INVESTIGATION RESULTS

4.1 Soil Sampling Results

As hydrocarbons migrate vertically through the vadose zone and horizontally via groundwater flow, a percentage of the hydrocarbons will become adsorbed to the soil particles. Soil borings to sample adsorbed phase hydrocarbons were collected by Geoprobe®.

Figure 2 illustrates Geoprobe® soil boring locations. Soil borings were collected to a depth of 8 feet. Table 1 describes each soil boring, as to the onsite apparent petroleum impact using visual and olfactory methods.

Table 1: Geoprobe® Soil Boring Field Observations

Boring ID	Description of Soil Boring
SB-1	No apparent petroleum odor or staining 4 ft sample analyzed
SB-2	No apparent petroleum odor or staining 6 ft sample analyzed
SB-3	Petroleum odor and staining starting at 3 ft, and continuing throughout the core. 5 ft sample analyzed
SB-4	Petroleum odor and staining at 3 ft, and continuing throughout the core. 6 ft sample analyzed
SB-5	Petroleum odor and staining, starting at 2' and continuing throughout the core. 5 ft sample analyzed
SB-6	Strong petroleum odor and staining starting at 2 ft, and continuing throughout the core. 5 ft sample analyzed

Field Work conducted on January 10, 2002

Soil samples from all borings were collected and sent to Environmental Science Corp. Laboratory in Mt. Juliet, Tennessee. Analytical results for those samples are summarized in Table 2, with the laboratory report located in Appendix B.

Table 2: Soil Analytical Results

ID	Parameter	Result	Units	DL	DF
SS-1-4	TPH-DRO(C10-C28)	BDL	mg/kg	4.8	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.60	5
	Benzene	BDL	mg/kg	0.0030	5
	Toluene	BDL	mg/kg	0.030	5
	Ethylbenzene	BDL	mg/kg	0.0030	5
	Xylene (total)	BDL	mg/kg	0.0090	5

ID	Parameter	Result	Units	DL	DF
SS-2-6	TPH-DRO(C10-C28)	BDL	mg/kg	4.7	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.59	5
	Benzene	BDL	mg/kg	0.0030	5
	Toluene	BDL	mg/kg	0.030	5
	Ethylbenzene	BDL	mg/kg	0.0030	5
	Xylene (total)	BDL	mg/kg	0.0089	5
SS-3-5	TPH-DRO(C10-C28)	BDL	mg/kg	4.7	1
	TPH-GRO (C6-C10)	1.0	mg/kg	0.59	5
	Benzene	0.0091	mg/kg	0.0029	5
	Toluene	BDL	mg/kg	0.029	5
	Ethylbenzene	BDL	mg/kg	0.0029	5
	Xylene (total)	0.0088	mg/kg	0.0088	5
SS-4-6	TPH-DRO(C10-C28)	BDL	mg/kg	4.8	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.60	5
	Benzene	BDL	mg/kg	0.0030	5
	Toluene	BDL	mg/kg	0.030	5
	Ethylbenzene	BDL	mg/kg	0.0030	5
	Xylene (total)	BDL	mg/kg	0.0090	5
SS-5-5	TPH-DRO(C10-C28)	BDL	mg/kg	4.7	1
	TPH-GRO (C6-C10)	BDL	mg/kg	0.59	5
	Benzene	BDL	mg/kg	0.0029	5
	Toluene	BDL	mg/kg	0.029	5
	Ethylbenzene	BDL	mg/kg	0.0029	5
	Xylene (total)	BDL	mg/kg	0.0088	5
SS-6-5	TPH-DRO(C10-C28)	1100	mg/kg	47	10
	TPH-GRO (C6-C10)	3400	mg/kg	120	1000
	Benzene	1.8	mg/kg	0.59	1000
	Toluene	BDL	mg/kg	5.9	1000
	Ethylbenzene	23	mg/kg	5.9	1000
	Xylene (total)	34	mg/kg	1.8	1000

DL – Detection Limit; **DF** - Dilution Factor; **BDL** - Below Detection Limit

On the west side of Battlefield Boulevard all but one soil sample SS-3-5 were below detection limits for TPH. SS-3-5 showed the presence of TPH-GRO at 1.0 mg/kg, along with trace benzene and xylene levels. These results are well below VDEQ reporting limits.

On the east side of Battlefield Boulevard, SS-6-5 reflected elevated concentrations of TPH and BTEX. This is consistent with results for GBW-2 which were presented in the August 28, 1995 report, and indicates that no significant degradation has occurred in the area of GBW-2 since the August 28, 1995 report.

Figure 3 is a site map illustrating the above analytical results in relation to the proposed storm sewer installation.

4.2 Water Sampling Results

Petroleum compounds with high solubilities may dissolve into the groundwater and be transported with groundwater flow. The dissolved hydrocarbons were assessed through groundwater sampling and analysis.

A stainless steel screen was advanced into each boring to a depth of 10 feet to collect groundwater samples. Groundwater samples were collected January 10, 2002 and shipped to Environmental Science Corp Laboratory in Mt. Juliet, Tennessee. Analytical results for these samples are summarized in Table 3, with the laboratory report located in Appendix B.

Table 3: Groundwater Analytical Results

ID	Parameter	Result	Units	DL	DF
WS-1	TPH-DRO(C10-C28)	0.27	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-2	TPH-DRO(C10-C28)	0.51	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-3	TPH-DRO(C10-C28)	0.46	mg/l	0.10	1
	TPH-GRO (C6-C10)	0.21	mg/l	0.10	1
	Benzene	0.0077	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	0.0016	mg/l	0.0015	1

ID	Parameter	Result	Units	DL	DF
WS-4	TPH-DRO(C10-C28)	0.53	mg/l	0.10	1
	TPH-GRO (C6-C10)	0.73	mg/l	0.10	1
	Benzene	0.0012	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	0.00059	mg/l	0.00050	1
	Xylene (total)	0.0081	mg/l	0.0015	1
WS-5	TPH-DRO(C10-C28)	0.26	mg/l	0.10	1
	TPH-GRO (C6-C10)	BDL	mg/l	0.10	1
	Benzene	BDL	mg/l	0.00050	1
	Toluene	BDL	mg/l	0.0050	1
	Ethylbenzene	BDL	mg/l	0.00050	1
	Xylene (total)	BDL	mg/l	0.0015	1
WS-6	TPH-DRO(C10-C28)	12	mg/l	0.10	1
	TPH-GRO (C6-C10)	4.3	mg/l	5.0	50
	Benzene	2.6	mg/l	0.025	50
	Toluene	BDL	mg/l	0.25	50
	Ethylbenzene	0.076	mg/l	0.025	50
	Xylene (total)	0.28	mg/l	0.075	50

DL – Detection Limit; **DF** - Dilution Factor; **BDL** - Below Detection Limit

WS-6 was collected adjacent to GBW-2, which in the August 28, 1995 report reflected levels of 24 mg/l GRO, 4.2 mg/l DRO and 3.84 Total BTEX. Therefore, no significant degradation has occurred in the area of GBW-2 since the August 28, 1995 report.

Figure 4 is a site map illustrating the above analytical results in relation to the proposed storm sewer installation.

5.0 CONCLUSIONS

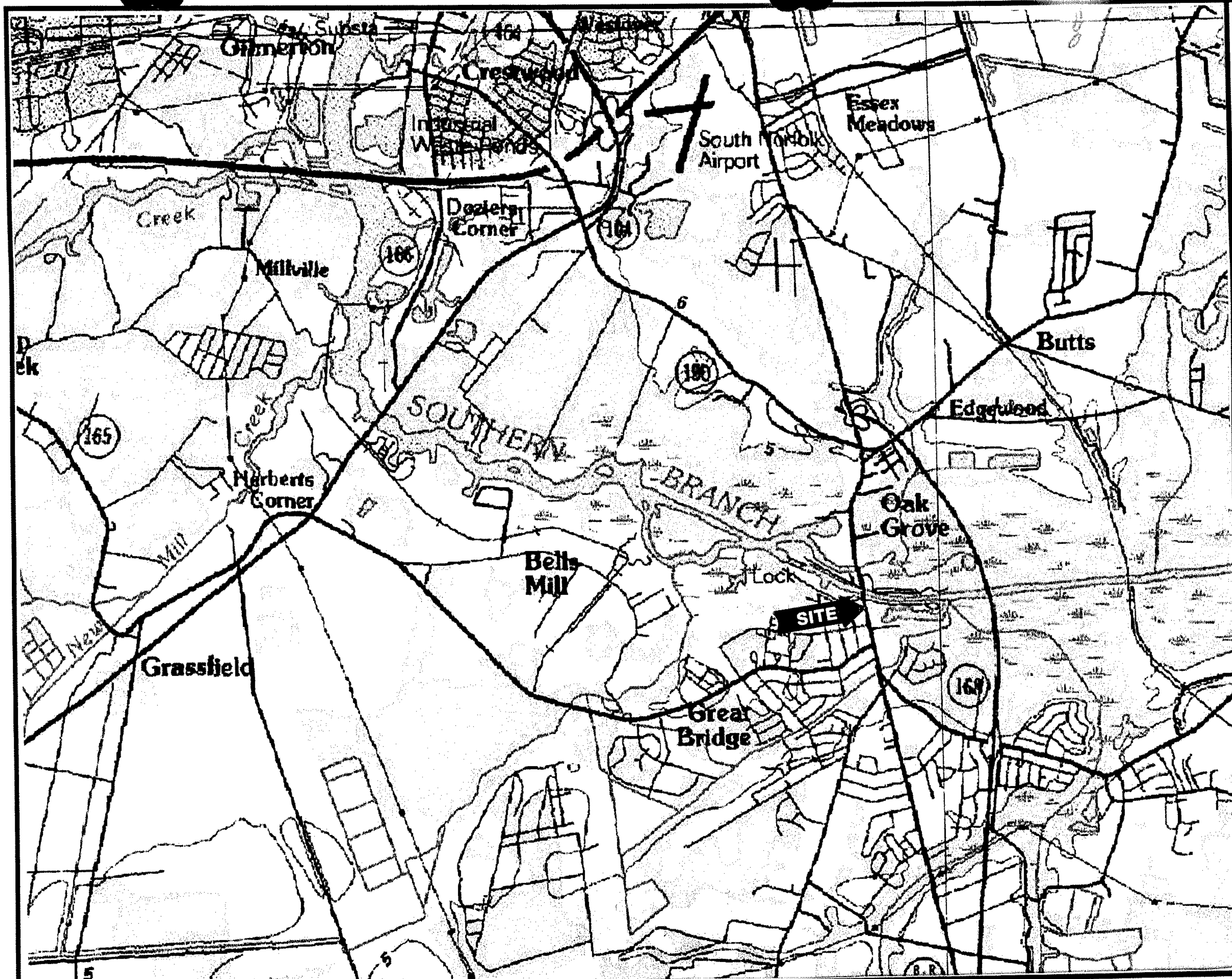
The storm sewer extension is shown in Figure 2. Soil borings SB-3, SB-4, and SB-5 are in the vicinity of the required excavation. Based on the soil and water samples collected, no worker safety or disposal issues exist on the west side of Battlefield Boulevard.

On the east side of Battlefield Boulevard the storm sewer will be located approximately 50 feet west of SS-6-5 and WS-6. These two samples showed significant hydrocarbon impact. Excavated soil for the storm sewer in this area should be screened for petroleum impact utilizing a flame ionization detector. Petroleum impacted soil should be segregated, stockpiled, sampled, and recycled or disposed of at an approved disposal/recycling facility.

Possible disposal methods include thermal destruction or landfarming; both of which are available in the Hampton Roads area. Costs for transportation and disposal of soil in the 5 to 10,000 mg/kg range, would be between $55 and $65 per cubic yard, depending on excavation and stockpiling procedures.

If dewatering is required to install the storm sewer section in this area, the removed water will require treatment or disposal. According to VDEQ Guidelines, hydrocarbon impacted water generated by construction activities can be treated and discharged to a grassy area and allowed to infiltrate back into the ground at the discretion and risk of the generator. The water can successfully be treated onsite by air stripping and/or carbon filtration bringing the TPH and BTEX concentrations to non-detectable levels. Field assay test kits or laboratory samples can be utilized to confirm water treatment prior to discharge. Cost for onsite treatment would be between $0.05 and $0.10 per gallon, depending on the flow rate and total volume treated.

FIGURES



Legend: 3222-Topo

Source:

Fentress, Virginia, U.S.G.S. 7.5-minute topographic series, photorevised 1986.

Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

Figure 1: Portion of U.S.G.S. Fentress, Virginia topographic map illustrating the location and topography of the site.

IMS ENVIRONMENTAL SERVICES

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 3222-Topo
Prepared By: CJS
Date: January 14, 2002

Approximate Scale:
1" = 1 Mile

APPENDIX B

Laboratory Analytical Report - Soil

ENVIRONMENTAL
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Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : WS-03
Collected By : Walter Bell
Collection Date : 04/22/02 11:10

ESC Sample # : L75312-01
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	0.41	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	96.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	0.42	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	77.		% Rec.	8015	04/23/02	1

Jimmy Hunt
Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:
The reported analytical results relate only to the sample submitted.
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P.O. Box 1779
Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : WS-04
Collected By : Walter Bell
Collection Date : 04/22/02 12:09

ESC Sample # : L75312-02
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	BDL	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	97.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	0.10	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	87.		% Rec.	8015	04/23/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

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P.O. Box 1779
Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : WS-05
Collected By : Walter Bell
Collection Date : 04/22/02 12:55

ESC Sample # : L75312-03
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	BDL	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	98.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	0.16	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	86.		% Rec.	8015	04/23/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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REPORT OF ANALYSIS

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Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : WS-06
Collected By : Walter Bell
Collection Date : 04/22/02 13:44

ESC Sample # : L75312-04
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	0.24	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	99.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	0.17	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	93.		% Rec.	8015	04/23/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
Note:
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Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : WS-07
Collected By : Walter Bell
Collection Date : 04/22/02 14:12

ESC Sample # : L75312-05
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	BDL	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	97.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	1.2	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	89.		% Rec.	8015	04/23/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
Note:
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Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-03-05
Collected By : Walter Bell
Collection Date : 04/22/02 10:55

ESC Sample # : L75312-06
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	82.3		%	2540G	04/23/02	1
Benzene	2.1	0.30	mg/kg	8021/8015	04/23/02	500
Toluene	BDL	3.0	mg/kg	8021/8015	04/23/02	500
Ethylbenzene	1.5	0.30	mg/kg	8021/8015	04/23/02	500
Total Xylene	2.0	0.91	mg/kg	8021/8015	04/23/02	500
TPH (GC/FID) Low Fraction	1700	61.	mg/kg	8015	04/23/02	500
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	91.		% Rec.	8021/8015	04/23/02	500
TPH (GC/FID) High Fraction	130	4.9	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	65.		% Rec.	8015	04/24/02	1

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

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REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-04-05
Collected By : Walter Bell
Collection Date : 04/22/02 11:50

ESC Sample # : L75312-07
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	80.8		%	2540G	04/23/02	1
Benzene	BDL	0.0031	mg/kg	8021/8015	04/23/02	5
Toluene	BDL	0.031	mg/kg	8021/8015	04/23/02	5
Ethylbenzene	BDL	0.0031	mg/kg	8021/8015	04/23/02	5
Total Xylene	BDL	0.0093	mg/kg	8021/8015	04/23/02	5
TPH (GC/FID) Low Fraction	BDL	0.62	mg/kg	8015	04/23/02	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	98.		% Rec.	8021/8015	04/23/02	5
TPH (GC/FID) High Fraction	6.4	5.0	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	76.		% Rec.	8015	04/24/02	1

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

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REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-05-05
Collected By : Walter Bell
Collection Date : 04/22/02 12:40

ESC Sample # : L75312-08
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	82.6		%	2540G	04/23/02	1
Benzene	BDL	0.0030	mg/kg	8021/8015	04/23/02	5
Toluene	BDL	0.030	mg/kg	8021/8015	04/23/02	5
Ethylbenzene	BDL	0.0030	mg/kg	8021/8015	04/23/02	5
Total Xylene	BDL	0.0091	mg/kg	8021/8015	04/23/02	5
TPH (GC/FID) Low Fraction	BDL	0.60	mg/kg	8015	04/23/02	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	97.		% Rec.	8021/8015	04/23/02	5
TPH (GC/FID) High Fraction	BDL	4.8	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	63.		% Rec.	8015	04/24/02	1

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

ENVIRONMENTAL SCIENCE CORP.

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-06-05
Collected By : Walter Bell
Collection Date : 04/22/02 13:42

ESC Sample # : L75312-09
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	82.0		%	2540G	04/23/02	1
Benzene	BDL	0.0030	mg/kg	8021/8015	04/23/02	5
Toluene	BDL	0.030	mg/kg	8021/8015	04/23/02	5
Ethylbenzene	BDL	0.0030	mg/kg	8021/8015	04/23/02	5
Total Xylene	BDL	0.0091	mg/kg	8021/8015	04/23/02	5
TPH (GC/FID) Low Fraction	BDL	0.61	mg/kg	8015	04/23/02	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	96.		% Rec.	8021/8015	04/23/02	5
TPH (GC/FID) High Fraction	BDL	4.9	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	65.		% Rec.	8015	04/24/02	1

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

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Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-07-05
Collected By : Walter Bell
Collection Date : 04/22/02 14:00

ESC Sample # : L75312-10
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	80.1		%	2540G	04/23/02	1
Benzene	BDL	0.0031	mg/kg	8021/8015	04/23/02	5
Toluene	BDL	0.031	mg/kg	8021/8015	04/23/02	5
Ethylbenzene	BDL	0.0031	mg/kg	8021/8015	04/23/02	5
Total Xylene	BDL	0.0094	mg/kg	8021/8015	04/23/02	5
TPH (GC/FID) Low Fraction	0.69	0.62	mg/kg	8015	04/23/02	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	100		% Rec.	8021/8015	04/23/02	5
TPH (GC/FID) High Fraction	140	5.0	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	71.		% Rec.	8015	04/24/02	1

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

ENVIRONMENTAL
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24,2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-08-05
Collected By : Walter Bell
Collection Date : 04/22/02 14:32

ESC Sample # : L75312-11
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	81.9		%	2540G	04/23/02	1
Benzene	BDL	0.0030	mg/kg	8021/8015	04/23/02	5
Toluene	BDL	0.030	mg/kg	8021/8015	04/23/02	5
Ethylbenzene	BDL	0.0030	mg/kg	8021/8015	04/23/02	5
Total Xylene	BDL	0.0092	mg/kg	8021/8015	04/23/02	5
TPH (GC/FID) Low Fraction	0.62	0.61	mg/kg	8015	04/23/02	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	96.		% Rec.	8021/8015	04/23/02	5
TPH (GC/FID) High Fraction	BDL	4.9	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	51.		% Rec.	8015	04/24/02	1

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

ENVIRONMENTAL
SCIENCE CORP.

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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : SB-09-05
Collected By : Walter Bell
Collection Date : 04/22/02 14:56

ESC Sample # : L75312-12
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Dry Result	Det. Limit	Units	Method	Date	Dil.
Total Solids	76.8		%	2540G	04/23/02	1
Benzene	BDL	0.0032	mg/kg	8021/8015	04/23/02	5
Toluene	BDL	0.032	mg/kg	8021/8015	04/23/02	5
Ethylbenzene	BDL	0.0032	mg/kg	8021/8015	04/23/02	5
Total Xylene	BDL	0.0098	mg/kg	8021/8015	04/23/02	5
TPH (GC/FID) Low Fraction	1.5	0.65	mg/kg	8015	04/23/02	5
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	98.		% Rec.	8021/8015	04/23/02	5
TPH (GC/FID) High Fraction	14.	5.2	mg/kg	8015	04/24/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	50.		% Rec.	8015	04/24/02	1

Jimmy Hunt

Jimmy Hunt, ESC Representative

Results listed are dry weight basis.
BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:

The reported analytical results relate only to the sample submitted

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REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002

Description : ACOE-Great Bridge

Sample ID : WS-08

Collected By : Walter Bell
Collection Date : 04/22/02 14:40

ESC Sample # : L75312-13

ESC Key : IMSENVVA-ACOE

Site ID :

Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	BDL	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	98.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	0.46	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	91.		% Rec.	8015	04/23/02	1

Jimmy Hunt

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:
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REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

April 24, 2002

Date Received : April 23, 2002
Description : ACOE-Great Bridge
Sample ID : WS-09
Collected By : Walter Bell
Collection Date : 04/22/02 15:04

ESC Sample # : L75312-14
ESC Key : IMSENVVA-ACOE
Site ID :
Project # : 351.3278

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Benzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Toluene	BDL	0.0050	mg/l	8021/8015	04/24/02	1
Ethylbenzene	BDL	0.00050	mg/l	8021/8015	04/24/02	1
Total Xylene	BDL	0.0015	mg/l	8021/8015	04/24/02	1
TPH (GC/FID) Low Fraction	BDL	0.10	mg/l	8015	04/24/02	1
Surrogate Recovery (70-130)						
a,a,a-Trifluorotoluene	98.		% Rec.	8021/8015	04/24/02	1
TPH (GC/FID) High Fraction	0.25	0.10	mg/l	8015	04/23/02	1
Surrogate Recovery (50-150)						
o-Terphenyl	76.		% Rec.	8015	04/23/02	1

Jimmy Hunt
Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
Note:
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Attachment A
List of Analytes with QC Qualifiers

Sample #	Analyte	Qualifier
L75312-01	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H
L75312-02	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H
L75312-03	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H
L75312-04	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H
L75312-05	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H
L75312-06	Benzene	F
	Toluene	F
	Ethylbenzene	F
	Total Xylene	F
	TPH (GC/FID) Low Fraction	F
L75312-13	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H
L75312-14	Benzene	H
	Toluene	H
	Ethylbenzene	H
	Total Xylene	H
	TPH (GC/FID) Low Fraction	H

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
F	SRN (EPA) - Diluted: The original sample was diluted due to high amounts of one or more target analytes. All associated method analytes will be subject to an elevated detection limit relative to the dilution factor.
H	RIN(EPA)-Re-Analyzed: The indicated analytical results were generated from a reinjection of the same sample extract or aliquot.

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable unless qualified as 'R' (Rejected).

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Chain of Custody
Page 1 of 2

L75312

IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

Alternate billing information:

Prepared by:

ENVIRONMENTAL SCIENCE CORP.
12065 Lebanon Road
Mt. Juliet, TN 37122
Phone (800) 767-5859
FAX (615) 758-5859

Report to: Mr. Rob Reali

Email: rreali@imsenv.com

Project Description: ACOE-Great Bridge

City/State Collected: CHESAPEAKE, VA

Phone: (757) 436-3000
FAX: (757) 436-5266

Client Project #: ~~24352C~~ 351.3278

Lab Project #: IMSENVVA-ACOE

Collected by (print): WALTER BELL

Site/Facility ID#:

P.O.#: 24352C

Collected by (signature): Walter Bell

Rush? (Lab MUST Be Notified)
___ Same Day 200%
X Next Day. per JH 100%
___ Two Day 50%

Date Results Needed: 4/24/02
Email? __No X Yes
FAX? __No __Yes

Packed on Ice N___ Y X

CoCode: IMSENVVA (lab use only)
Template/Prelogin T14090/ P55383
Cooler #: 4/18/02 TB
Shipped Via: FedEX Standard

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	BTEX,GRO 2ozClr-NoPres	BTEX,GRO 40mlAmb-HCl	DRO 1L-Amb-Add HCl	DRO 4ozClr-NoPres	TS 2ozClr-NoPres	Remarks/Contaminant	Sample # (lab only)
WS-03	C	GW		4/22/02	1110	3		X	X				L75312-01
WS-04	C	GW		4/22/02	1209	3		X	X				-02
WS-05	C	GW		4/22/02	1255	3		X	X				-03
WS-06	C	GW		4/22/02	1344	3		X	X				-04
WS-07	C	GW	~~1412~~	4/22/02	1412	3		X	X				-05
SB-03-05	C	SS		4/22/02	1055	3	X			X	X		-06
SB-~~03~~-04-05	C	SS		4/22/02	1150	3	X			X	X		-07
SB-05-05	C	SS		4/22/02	1240	3	X			X	X		-08
SB-06-05	C	SS		4/22/02	1342	~~3~~ 2	X			X	~~X~~	NO T.S.	-09

*Matrix: **SS** - Soil **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other______

Remarks:

pH ________ Temp ________
Flow ________ Other ________

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Samples returned via: ☐ UPS ☐ FedEx ☐ Courier ☐ ____	Condition: (lab use only)
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3C Bottles Received: 39+TB	OK
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature) [signature]	Date: 4-23-02 Time: 10:00	pH Checked: <2 NCF:

IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

Alternate billing information:

Chain of Custody
Page 2 of 2

Prepared by:
Environmental Science Corp.
12065 Lebanon Road
Mt. Juliet, TN 37122
Phone (800) 767-5859
FAX (615) 758-5859

Report to: **Mr. Bob May**
Email: **rmay@imsenv.com**

Project Description: ACOE : GREAT BRIDGE
City/State Collected: CHESAPEAKE, VA

Phone: **(757) 436-3000**
FAX: **(757) 436-5266**
Client Project #: 351.3278
Lab Project #: IMSENVVA-ACOE

Collected by (print): WALTER BELL
Site/Facility ID#:
P.O.#: 24352C

Collected by (signature): Walter J Bell

Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___Same Day 200%
___Next Day. 100%
___Two Day 50%

Date Results Needed
Email? __No X Yes
FAX? __No __Yes

CoCode: **IMSENVVA** (lab use only)
Template/Prelogin **T14090/ P55383**
Cooler #:
Shipped Via: **FedEX Standard**

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	BTEX,GRO 2ozClr-NoPres	BTEX,GRO 40mlAmb-HCl	DRO 1L-Amb-Add HCl	DRO 4ozClr-NoPres	TS 2ozClr-NoPres				Remarks/Contaminant	Sample # (lab only)
SB-07-05	C	SS		4/22/02	1400	~~3~~ 2	X			X	~~X~~				NO T.S.	L75312-10
SB-08-05	C	SS		4/22/02	1432	2	X			X						-11
SB-09-05	C	SS		4/22/02	1456	2	X			X						-12
WS-08	C	GW		4/22/02	1440	3	~~X~~	X	X	~~X~~						-13
WS-09	C	GW		4/22/02	1504	3	~~X~~	X	X	~~X~~						-14

*Matrix: **SS** - Soil **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other________

Remarks:

pH ________ Temp ________
Flow ________ Other ________

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Samples returned via: ☐ UPS ☐ FedEx ☐ Courier ☐ ____	Condition: (lab use only)
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3°C Bottles Received: 39+13	OK
Relinquished by: (Signature)	Date	Time:	Received for lab by: (Signature)	Date: 4-23-02 Time: 10:00	pH Checked: C2 NCF:

Mailing Address: P.O. Box 1779
Norfolk, VA 23501-1779
Shipping Address: 1301 Marsh Street
Norfolk, VA 23501

24 Hours: (757) 543-5718
1-800-229-4671
Fax: (757) 543-4561

IMS
ENVIRONMENTAL SERVICES

September 26, 2002

Mr. Marc Gutterman
United States Army Corps of Engineers, Norfolk District
GeoEnvironmental Branch
803 Front Street
Norfolk, Virginia 23510

Re: Report of Findings
Great Bridge Water and Soil Lead Investigation

Dear Mr. Gutterman:

Please find below a brief narrative of the field work performed at North and South approaches to the Battle Blvd. Great Bridge Replacement Project. Also attached are a set of site plans showing the location of 7 borings at the site (figures 1 & 2) and the analytical results of that sampling.

IMS mobilized to the site on September 11, 2002, and performed 3 Geoprobe borings on the south side of the Intercoastal Waterway and 4 boring on the north side.

Water samples were collected in all 7 locations for Total Lead and for Dissolved Lead. Dissolved lead samples were filtered in the field while the total lead samples were unfiltered. Soil samples were collected in sample locations 1 through 5 for TCLP Lead.

The sample results as well as the depth the soil samples were collected, are shown in the table below.

Sample Point	Non-Filtered Water Sample (mg/l)	Filtered Water Sample (mg/l)	TCLP Soil Sample (mg/l)	Soil Depth (ft)
1	0.029	0.013	BDL	3.5-4
2	0.047	0.012	BDL	3.5-4
3	0.077	0.005	BDL	3.5-4
4	0.0087	0.0086	BDL	5-6
5	0.017	0.012	BDL	3-5
6	0.025	0.011	**	**
7	0.028	0.011	**	**

*Sample Not Collected

All samples were analyzed by Environmental Science Corp (ESC), in Mt. Juliet, Tennessee. ESC is an Army Corp Certified Laboratory. The complete analytical results are also included in this package.

Should you have any questions, please contact me at (757) 436-3000.

Sincerely,

IMS ENVIRONMENTAL SERVICES

Robert S. Reali, P.E.
Project Manager

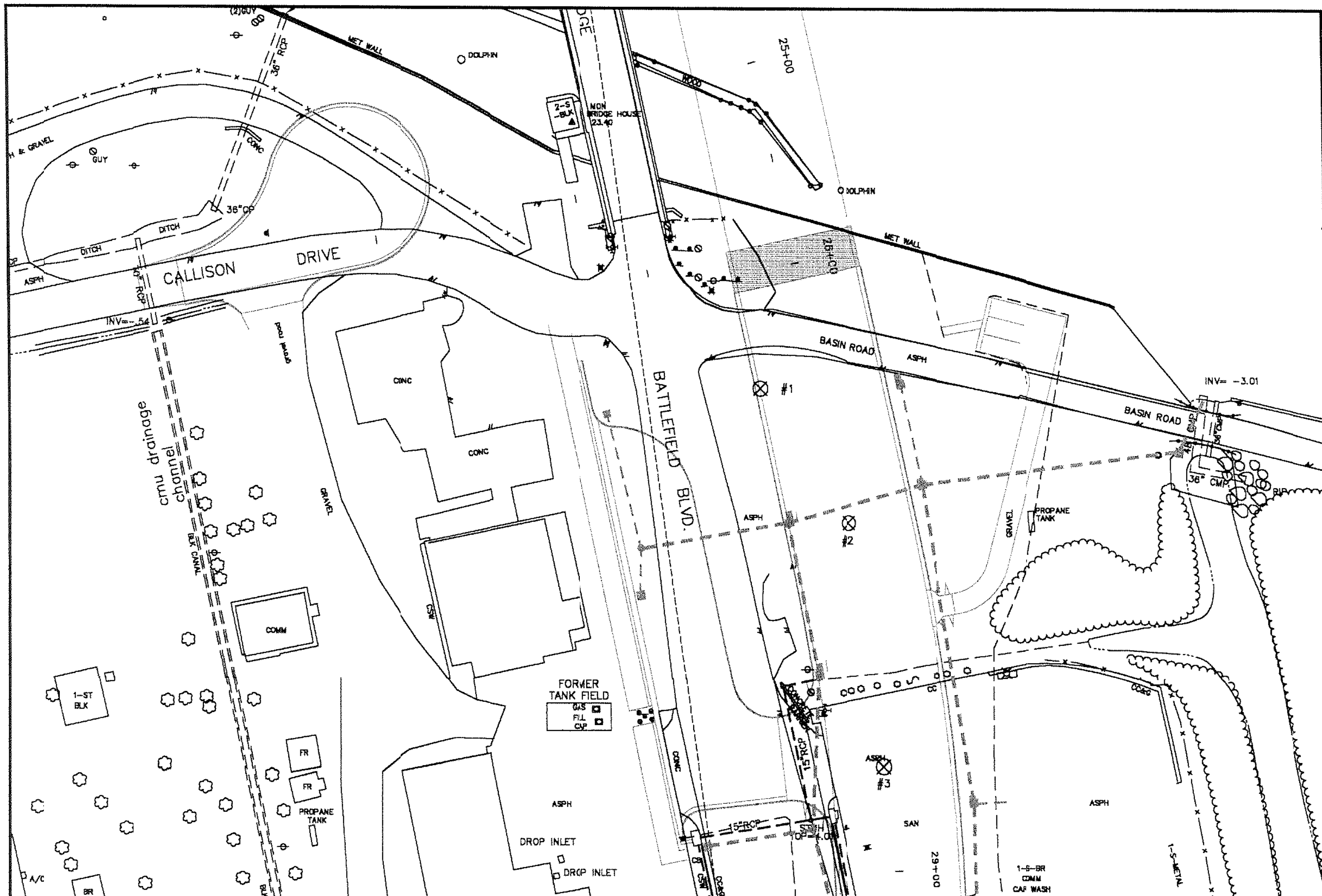


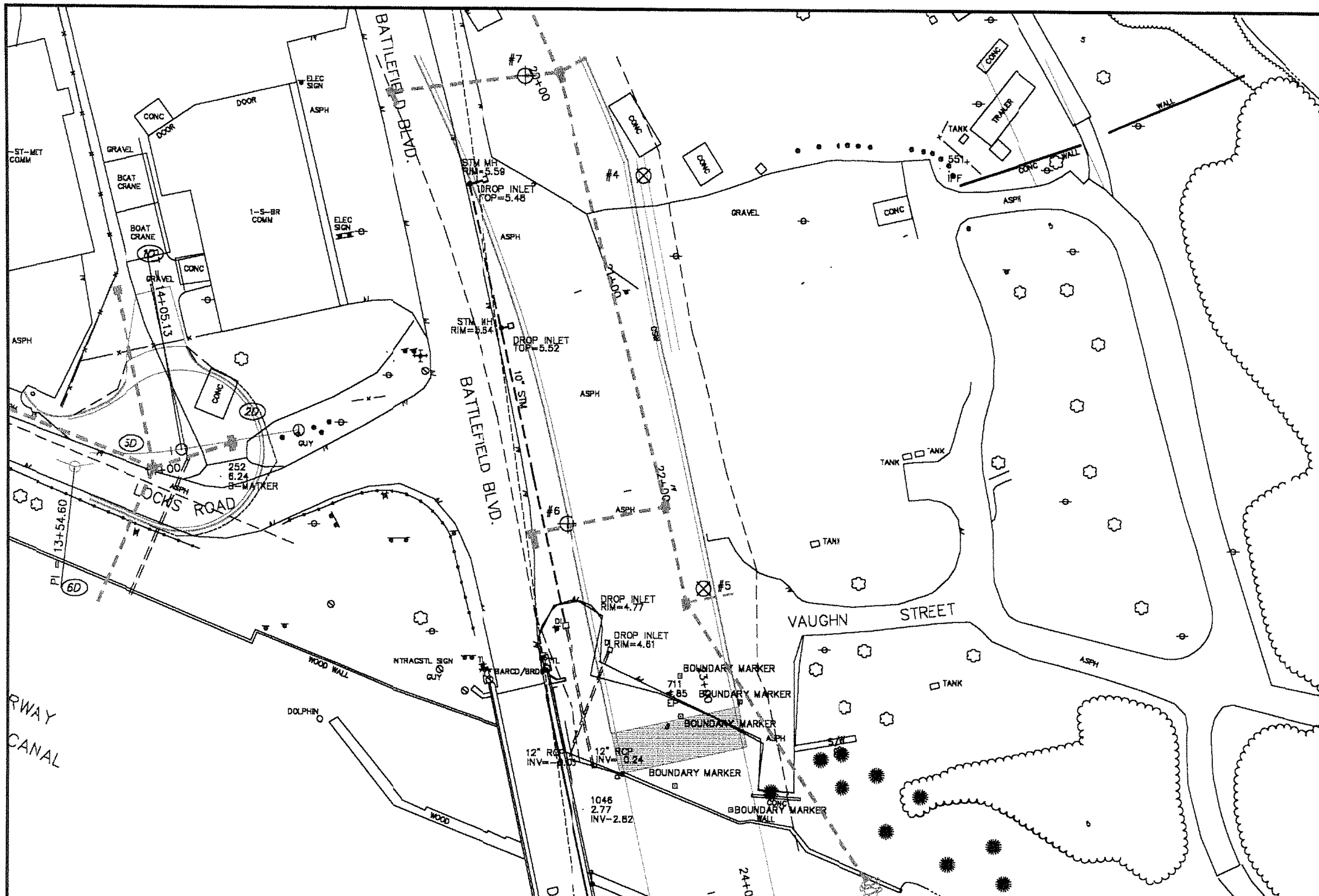
Figure 1: Site map illustrating water and soil sampling locations including analytical results. Data collected on September 11, 2002.

Site Location:
Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 351.3335
Prepared By: CJS
Date: September 24, 2002

Approximate Scale: 0 10 20 30 40 50
1" = 50'



Legend: 351.3335

⊕ Sample Point (water only)

⊗ Sample Point (water & soil)

Existing Storm Sewer

Proposed Storm Sewer

Proposed Bridge/Curbing

SAMPLE POINT #4

NON-FILTERED WATER SAMPLE (mg/L): 0.0087

FILTERED WATER SAMPLE (mg/L): 0.0086

TCLP SOIL SAMPLE (mg/L): BDL
SAMPLE DEPTH (FT): 5-3

SAMPLE POINT #5

NON-FILTERED WATER SAMPLE (mg/L): 0.017

FILTERED WATER SAMPLE (mg/L): 0.012

TCLP SOIL SAMPLE (mg/L): BDL
SAMPLE DEPTH (FT): 3-5

SAMPLE POINT #6

NON-FILTERED WATER SAMPLE (mg/L): 0.025

FILTERED WATER SAMPLE (mg/L): 0.011

TCLP SOIL SAMPLE (mg/L): SAMPLE NOT COLLECTED

SAMPLE POINT #7

NON-FILTERED WATER SAMPLE (mg/L): 0.028

FILTERED WATER SAMPLE (mg/L): 0.011

TCLP SOIL SAMPLE (mg/L): SAMPLE NOT COLLECTED

Figure 2: Site map illustrating water and soil sampling locations including analytical results. Data collected on September 11, 2002.

Site Location:

Great Bridge
Bridge Construction
Battlefield Blvd. South
Chesapeake, Virginia

NORTH

IMS ENVIRONMENTAL SERVICES
P.O. BOX 1779
Norfolk, Virginia 23501-1779

Project No: 351.3335
Prepared By: CJS
Date: September 24, 2002

Approximate Scale:
0 10 20 30 40 50
1" = 50'

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Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

September 19, 2002

ESC Sample # : L89204-01

Site ID :

Project # : 351.3335

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : WS-1 NF

Collected By : DC
Collection Date : 09/11/02 10:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.029	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

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Norfolk, VA 23501-1779

September 19, 2002

ESC Sample # : L89204-02

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-1 F

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 10:10

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead,Dissolved	0.013	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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September 19, 2002

ESC Sample # : L89204-03

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-2 NF

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 11:25

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.047	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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P.O. Box 1779
Norfolk, VA 23501-1779

September 19, 2002

ESC Sample # : L89204-04

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-2 F

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 11:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead,Dissolved	0.012	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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September 19, 2002

ESC Sample # : L89204-05

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-3 NF

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 12:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.077	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Norfolk, VA 23501-1779

September 19, 2002

ESC Sample # : L89204-06

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-3 F

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 12:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead,Dissolved	0.0057	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Norfolk, VA 23501-1779

September 19, 2002

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : WS-4 NF

Collected By : DC
Collection Date : 09/11/02 13:35

ESC Sample # : L89204-07

Site ID :

Project # : 351.3335

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.0087	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Norfolk, VA 23501-1779

September 19, 2002

ESC Sample # : L89204-08

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-4 F

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 13:45

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead,Dissolved	0.0086	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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September 19, 2002

ESC Sample # : L89204-09

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-5 NF

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 14:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.017	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

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September 19, 2002

ESC Sample # : L89204-10

Site ID :

Project # : 351.3335

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : WS-5 F

Collected By : DC
Collection Date : 09/11/02 14:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead, Dissolved	0.012	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Norfolk, VA 23501-1779

September 19, 2002

ESC Sample # : L89204-11

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-6 NF

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 15:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.025	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

September 19, 2002

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : WS-6 F

Collected By : DC
Collection Date : 09/11/02 15:05

ESC Sample # : L89204-12

Site ID :

Project # : 351.3335

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead,Dissolved	0.011	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)

Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233

Note:
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September 19, 2002

ESC Sample # : L89204-13

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-7 NF

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 15:35

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead	0.028	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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September 19,2002

ESC Sample # : L89204-14

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : WS-7 F

Project # : 351.3335

Collected By : DC
Collection Date : 09/11/02 15:40

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Lead,Dissolved	0.011	0.0050	mg/l	6010B	09/17/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Norfolk, VA 23501-1779

September 19,2002

ESC Sample # : L89204-15

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : SS-1 3.5-4 FT

Project : 351.3335

Collected By : DC
Collection Date : 09/11/02 09:40

Parameter	Result	Det. Limit	Units	Reg. Limit	Method	Date	Dil
TCLP Extraction	-				1311	09/18/02	1
Lead	BDL	0.050	mg/l	5.0	6010B	09/19/02	1

Jimmy Hunt
Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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Norfolk, VA 23501-1779

September 19,2002

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : SS-2 3.5-4 FT

Collected By : DC
Collection Date : 09/11/02 10:45

ESC Sample # : L89204-16

Site ID :

Project : 351.3335

Parameter	Result	Det. Limit	Units	Reg. Limit	Method	Date	Dil
TCLP Extraction	-				1311	09/18/02	1
Lead	BDL	0.050	mg/l	5.0	6010B	09/19/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
Note:
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P.O. Box 1779
Norfolk, VA 23501-1779

September 19,2002

ESC Sample # : L89204-17

Date Received : September 12, 2002
Description : ACOE Great Bridge

Site ID :

Sample ID : SS-3 3.5-4 FT

Project : 351.3335

Collected By : DC
Collection Date : 09/11/02 12:05

Parameter	Result	Det. Limit	Units	Reg. Limit	Method	Date	Dil
TCLP Extraction	-				1311	09/18/02	1
Lead	BDL	0.050	mg/l	5.0	6010B	09/19/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
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P.O. Box 1779
Norfolk, VA 23501-1779

September 19,2002

ESC Sample # : L89204-18

Site ID :

Project : 351.3335

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : SS-4 5-6 FT

Collected By : DC
Collection Date : 09/11/02 13:30

Parameter	Result	Det. Limit	Units	Reg. Limit	Method	Date	Dil
TCLP Extraction	-				1311	09/18/02	1
Lead	BDL	0.050	mg/l	5.0	6010B	09/19/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
Note:
The reported analytical results relate only to the sample submitted.
This report shall not be reproduced, except in full, without the written approval from ESC.

ENVIRONMENTAL
SCIENCE CORP.

12065 Lebanon Rd.
Mt. Juliet, TN 37122
(615) 758-5858
1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Rob Reali
IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk, VA 23501-1779

September 19,2002

Date Received : September 12, 2002
Description : ACOE Great Bridge

Sample ID : SS-5 3-5 FT

Collected By : DC
Collection Date : 09/11/02 13:55

ESC Sample # : L89204-19

Site ID :

Project : 351.3335

Parameter	Result	Det. Limit	Units	Reg. Limit	Method	Date	Dil
TCLP Extraction	-				1311	09/18/02	1
Lead	BDL	0.050	mg/l	5.0	6010B	09/19/02	1

Jimmy Hunt, ESC Representative

BDL - Below Detection Limit
Det. Limit - Estimated Quantitation Limit(EQL)
Laboratory Certification Numbers:
A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT- PH-0197, FL - E87487, GA - 923, IN - C-TN-01
KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140, SC - 84004, TN - 2006, VA - 00109, WV - 233
Note:
The reported analytical results relate only to the sample submitted.
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ENVIRONMENTAL SCIENCE CORPORATION
QUALITY/CUSTOMER SERVICE SURVEY

CLIENT INFORMATION:
Client Company ____________________
Client Contact ____________________

PROJECT INFORMATION
Project Name: ____________________
Project No. ____________________

INTRODUCTION:
We at Environmental Science Corporation would like to ask you to help us improve our service and provide better value to you our client by answering a few short questions that rate our performance on a scale of 1 to 5. A rating of "1" indicates we did NOT meet your requirements: a rating of "3" indicates we met your requirements: and a rating of "5" indicates we exceeded your requirements.

Timeliness	Were our reports delivered on time?	1 2 3 4 5
	Did we return your calls promptly?	1 2 3 4 5
	Did we solve problems quickly?	1 2 3 4 5

Comments: ____________________.

Quality	Did the Report meet your project requirements?	1 2 3 4 5
	Did the data meet your project requirements?	1 2 3 4 5

Comments: ____________________.

Dependability	Did we keep our promises?	1 2 3 4 5
	Did we exhibit our ability to solve problems?	1 2 3 4 5

Comments: ____________________.

Cooperativeness:	Were we courteous and responsive?	1 2 3 4 5
	Were we flexible?	1 2 3 4 5
	Did we take care of your issues?	1 2 3 4 5

Comments: ____________________.

Communication:	Were we easy to contact?	1 2 3 4 5
	Were our responses prompt and informative?	1 2 3 4 5
	Did we provide sample receipt information?	1 2 3 4 5
	Did we provide status/updates as necessary?	1 2 3 4 5
	How well did we handle emergencies?	1 2 3 4 5

Comments: ____________________.

Overall--Please grade the following

Your Technical Service Representative (TSR)	1 2 3 4 5
Our performance against scope	1 2 3 4 5
Our communication	1 2 3 4 5
Our report	1 2 3 4 5
Our invoice	1 2 3 4 5

Closing
Thank you very much for your time. We very much appreciate your willingness to respond to this survey. Each survey will be reviewed by our Client Service Director. We would like to ask you one final question.
Is there anything that you would like to comment on that was not covered in this survey?

1.

2.

3.

Please return survey by:
Fax: 615-758-5859
To email a copy, see our web site at www.envsci.com

Company Name/Address:

IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk.VA 23501-1779

Alternate billing information:

Chain of Custody Page 1 of 3

Prepared by:

ENVIRONMENTAL SCIENCE CORP.
12065 Lebanon Road
Mt. Juliet, TN 37122
Phone (615) 758-5858
Phone (800) 767-5859
FAX (615) 758-5859

Report to: IMS Rob Reali

Email to: RReali@IMSENV.com

Project Description: ACOE Great Bridge

City/Sate Collected

Phone: (757) 436-3000
FAX: (757) 436-5266

Client Project #: 351.3335

ESC Key:

Collected by: DC

Site/Facility ID#:

P.O.#: 32224C

Collected by (signature): DC

Packed on Ice N (Y)

Rush? (Lab MUST Be Notified)
_____ Same Day. 200%
_____ Next Day.. . . . . . . 100%
_____ Two Day 50%

Date Results Needed:
Email? __No X Yes
FAX? __No X Yes

Analysis/Container/Preservative

CoCode **IMSENVVA** (lab use only)
Template/Prelogin
Shipped Via:

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	TOTAL PB	DISSOLVED PB	Remarks/Contaminant	Sample # (lab only)
WS1 NF	GRAB	H2O	N/A	9/11/02	1000	1	X			L89204-01
WS1 F					1010	1		X		02
WS2 NF					1125	1	X			03
WS2 F					1135	1		X		04
WS3 NF					1230	1	X			05
WS3 F					1235	1		X		06
WS4 NF					1335	1	X			07
WS4 F					1345	1		X		08
WS5 NF					1430	1	X			09

*Matrix: **SS** - Soil/Solid **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other________

Remarks:

pH ________ Temp ________

Flow ________ Other ________

Relinquished by: (Signature) DC	Date: 9/11/02	Time: 1645	Received by: (Signature)	Samples returned via: ☐ UPS ☒ FedEx ☐ Courier ☐	Condition: OK (lab use only)
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3° / Bottles Received: 19	
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/12/02 / Time: 945	pH Checked: c2 / NCF:

Company Name/Address:

IMS Environmental Services-Virginia
P.O. Box 1779
Norfolk.VA 23501-1779

Alternate billing information:

Chain of Custody Page 2 of 3

Prepared by:

ENVIRONMENTAL SCIENCE CORP.
12065 Lebanon Road
Mt. Juliet, TN 37122
Phone (615) 758-5858
Phone (800) 767-5859
FAX (615) 758-5859

Report to: IMS Rob Real.
Email to: RReal@IMSenv.com

Project Description: ACOE Great Bridge
City/State Collected:

Phone: (757) 436-3000
FAX: (757) 436-5266
Client Project #: 351.3335
ESC Key:

Collected by: DC
Site/Facility ID#:
P.O.#: 32224C

Collected by (signature):
Packed on Ice N Y

Rush? (Lab MUST Be Notified)
___ Same Day.......200%
___ Next Day.......100%
___ Two Day........50%

Date Results Needed:
Email? __No__Yes
FAX? __No__Yes

CoCode **IMSENVVA** (lab use only)
Template/Prelogin
Shipped Via:

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	TOTAL PB	DISSOLVED PB							Remarks/Contaminant	Sample # (lab only)
WS5F	GRAB	H2O	N/A	9/11/02	1435	1		X								L89204 10
WS6NF	↓	↓	↓	↓	1500	1	X									11
WS6F	↓	↓	↓	↓	1505	1		X								12
WS7NF	↓	↓	↓	↓	1535	1	X									13
WS7F	↓	↓	↓	↓	1540	1		X								14

*Matrix: SS - Soil/Solid GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other______

pH ______ Temp ______

Remarks:

Flow ______ Other ______

Relinquished by: (Signature)	Date: 9/11/02	Time: 1645	Received by: (Signature)	Samples returned via: ☐ UPS ☒ FedEx ☐ Courier ☐	Condition: (lab use only) OK
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3°C / Bottles Received: 19	
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/12/02 / Time: 945	pH Checked: <2 / NCF:

Company Name/Address:

IMS Environmental Services-Virginia

P.O. Box 1779
Norfolk.VA 23501-1779

Alternate billing information:

Chain of Custody Page 3 of 3

Prepared by:

ENVIRONMENTAL SCIENCE CORP.
12065 Lebanon Road
Mt. Juliet, TN 37122
Phone (615) 758-5858
Phone (800) 767-5859
FAX (615) 758-5859

Report to: IMS ROB REAL

Email to: RREAL@IMSENV.com

Project Description: ACOE GREAT BRIDGE

City/Sate Collected

Phone: (757) 436-3000
FAX: (757) 436-5266

Client Project #: 351.3335

ESC Key:

Collected by: DC

Site/Facility ID#

P.O.#: 32224C

Collected by (signature):

Packed on Ice N Y ✓

Rush? (Lab MUST Be Notified)
_____ Same Day.......200%
_____ Next Day........100%
_____ Two Day.........50%

Date Results Needed:
Email? __No ✓ Yes
FAX? __No ✓ Yes

CoCode **IMSENVVA** (lab use only)
Template/Prelogin
Shipped Via:

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	TCLP LEAD							Remarks/Contaminant	Sample # (lab only)
SS1	GRAB	SOIL	3.5-4FT	9/11/02	0940	1	X								L89201-15
SS2	↓	↓	3.5-4FT	↓	1045	1	X								16
SS3	↓	↓	3.5-4FT	↓	1205	1	X								17
SS4	↓	↓	5-6FT	↓	1330	1	X								18
SS5	↓	↓	3-5FT	↓	1355	1	X								19

*Matrix: **SS** - Soil/Solid **GW** - Groundwater **WW** - WasteWater **DW** - Drinking Water **OT** - Other__________

Remarks:

pH __________ Temp __________
Flow __________ Other __________

Relinquished by: (Signature)	Date: 9/11/02	Time: 1645	Received by: (Signature)	Samples returned via: ☐ UPS ☒ FedEx ☐ Courier ☐	Condition: (lab use only) OK
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 3°C / Bottles Received: 19	
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9/12/02 / Time: 945	pH Checked: <2 / NCF:

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-1

Depth (ft)	Blows/6'	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0							Topsoil
							Gray to tan coarse to medium SAND with some pebbles. No odors
4		0"					No Recovery, characterized soils using cuttings
6	2/2'	5"		0.0			Same as above but wet. Possible organic odors

Depth scale: 5, 10, 15, 20

Job Name: Great Bridge North Approach
Depth to Water:
Job Number: 2976.002
Signature:
Client Name: Army Corp of Engineers
Drill Method: HSA
Boring Number: SB-1
Date Completed: 8/21/95
Geologist: Mike Bruzzesi
Date: 8/21/95

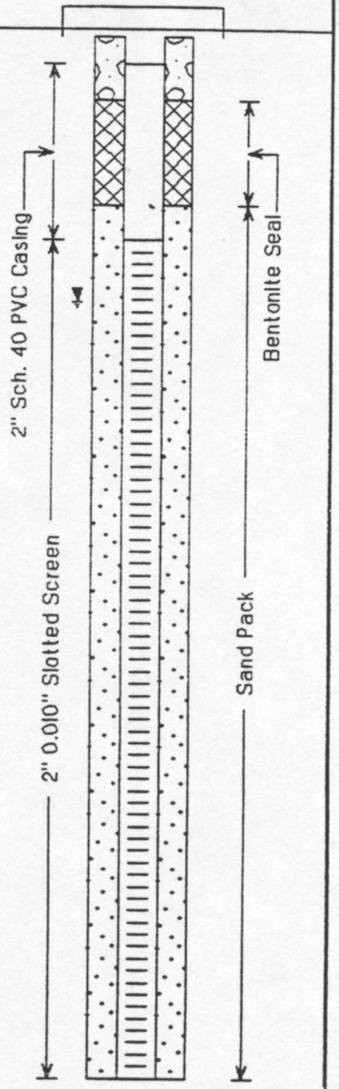
VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-2/SB-2

Depth (ft)	Date	Time	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0									Asphalt
									Gray medium to coarse SAND with organic materials and odors
4–5			1 1 1 3	15"	0				
9–10			1 1 8 4	18"	0				Same as above, wet

Depth scale: 5, 10, 15, 20

Well Contruction Summary



Job Name	Great Bridge North Approach	Date Started	8/21/95	Drill Method	HSA
Job Number	2976.002	Date Completed	8/21/95	Casing Diameter	2"
Client Name	Army Corp of Engineers	Total Depth	14.12 Feet BEG	Screen Interval	3 to 15 Feet BEG
Location	Great Bridge, Virginia	Water Level	3.90 Feet BEG	Slot Size	0.010
Boring Number	MW-2/SB-2	Surface Elevation	MSLD	Drilling Co.	Connelly and Associates
Geologist	Mike Bruzzesi	Signature		Date	

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-3

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Topsoil
5	H/2'	0"		0.0			(No Recovery, used cuttings to characterize soils)
							Gray medium SAND with little clays and silts. Organic odors
10							
15							
20							

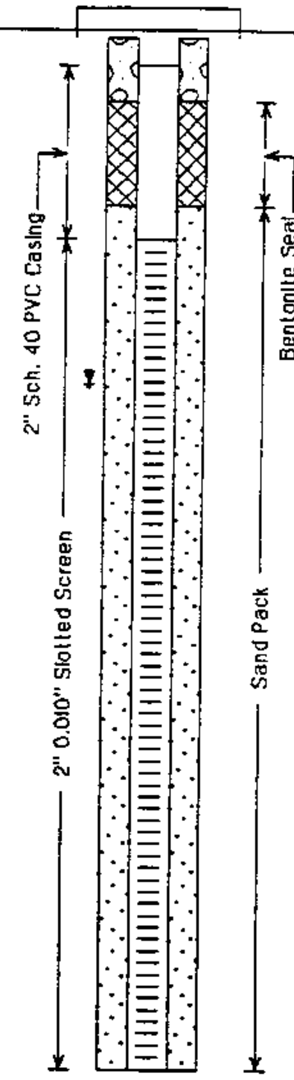
Job Name Great Bridge North Approach
Job Number 2978.002
Client Name Army Corp of Engineers
Boring Number SB-3
Geologist Mike Bruzzesi
Depth to Water
Signature
Drill Method HSA
Date Completed 8/21/95
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-1/SB-4

Depth (ft)	Date	Time	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0									Asphalt
									Brown Coarse to medium SAND with pebbles and strong petroleum odors
5			H/2'	0"		5			
			H/2'	0"		1			Same as above with wood encountered and petroleum odors
10			H/1' 2	18"		20			Tan coarse to medium SAND. Wet with petroleum odors
15									
20									

Well Contruction Summary



Job Name: Great Bridge North Approach	Date Started: 8/21/95	Drill Method: HSA
Job Number: 2978.002	Date Completed: 8/21/95	Casing Diameter: 2"
Client Name: Army Corp of Engineers	Total Depth: 15.08 Feet BEG	Screen Interval: 3 to 15 Feet BEG
Location: Great Bridge, Virginia	Water Level: 5.08 Feet BEG	Slot Size: 0.010
Boring Number: MW-1/SB-4	Surface Elevation: MSLD	Drilling Co.: Connelly and Associates
Geologist: Mike Bruzzesi	Signature:	Date:

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-5

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
							Gray coarse to medium SAND
5	1 1 1 1	0"		0.0			
	1 2 3 6	5"		15			No Recovery, used cuttings to characterize soils Brown medium SAND with little silt. Wet wood, no odors
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-5
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-6

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0							Asphalt
							Medium brown medium SANDS with black organic material
5	1 1 1 1	8"		1			
	1 5 9 11	3"		1			Same as above. Wood encountered
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-6
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-7

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
							Concrete
5	1 1 18 50/4"	20"		0			Gray medium SANDS with little silt and trace clay. 3-inch humus layer and 8-inches of wood with a strong putrid odor
				0			No Recovery, used cuttings to characterize soils (wood blocked spoon)
10							
15							
20							

Job Name Great Bridge North Approach
Job Number 2976.002
Client Name Army Corp of Engineers
Boring Number SB-7
Geologist Mike Bruzzesi
Depth to Water
Signature
Drill Method HSA
Date Completed 8/21/95
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-8

Depth (ft)	Blows/ft	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
							Gray medium SANDS with some clay and little silt. Wood present. No odors
5	2 1 1 1	18"		0			
	1 1 3 7	15"		0			Medium brown SAND with organics
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2976.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-8
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-9

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
							Gray medium SANDS with organic matter
5	3 1 1 1	18"		0			
	1 2 4 8	23"		0			Medium brown coarse to medium clean SAND some organic matter. Strong petroleum odors
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-9
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-10

Depth (ft)	Blows/8"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
							Concrete
							Gravel
5	4 3 3 3	12"		2			Medium brown coarse to medium clean SAND with strong petroleum odors. shell fragments
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-10
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-11

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0							Asphalt
5	2 2 2 3	18"		2			Medium brown medium to coarse SAND with strong petroleum odors. Shell fragments
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-11
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-12

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
							Concrete
5	5 6 7 8	18"		0			Gray coarse to medium SAND with slight (possible) petroleum odors
10							
15							
20							

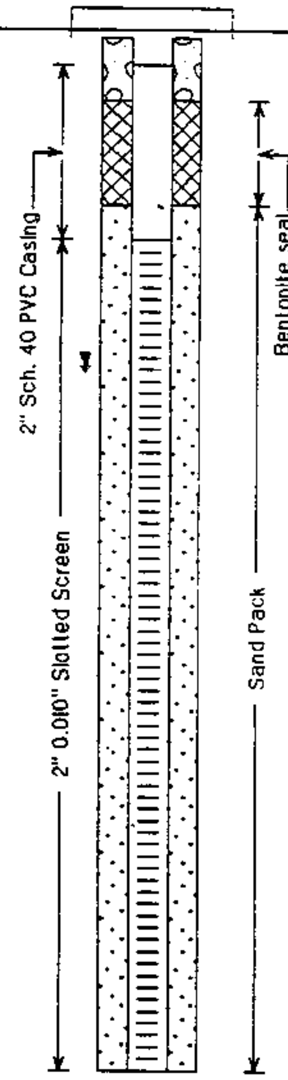
Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-12
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-4/SB-13

Depth (ft)	Date	Time	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
									gravel
									Dark gray coarse to medium SAND
									Light gray coarse to medium SAND
5			1 1 1 2	24"		80			Medium brown coarse to medium SAND with organic matter and strong petroleum odors
10									
15									
20									

Well Contruction Summary



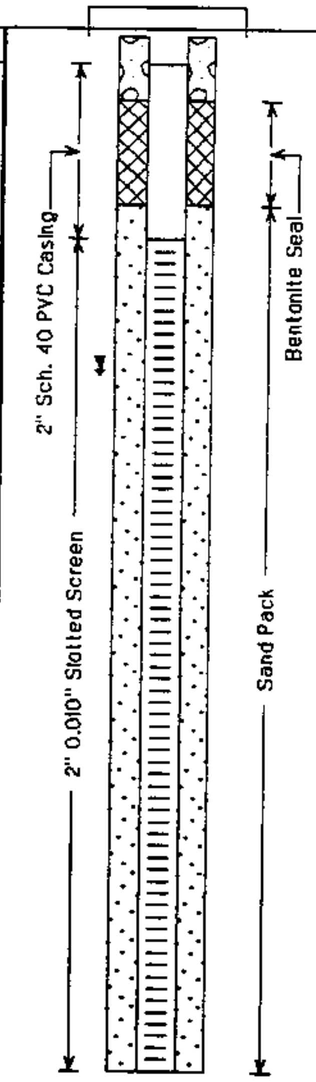
Job Name	Great Bridge North Approach	Date Started	8/21/95	Drill Method	HSA
Job Number	2978.002	Date Completed	8/21/95	Casing Diameter	2"
Client Name	Army Corp of Engineers	Total Depth	14.75 Feet BEG	Screen Interval	3-15' Feet BEG
Location	Great Bridge, Virginia	Water Level	4.84 Feet BEG	Slot Size	0.010
Boring Number	MW-4/SB-13	Surface Elevation	MSLD	Drilling Co.	Connelly and Associates
Geologist	Mike Bruzzesi	Signature		Date	

VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-5/SB-14

Depth (ft)	Date	Time	Blows/6'	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0									Asphalt
4			1 1 1 1	17"		5			Gray medium to coarse to medium SAND with strong petroleum odors
9			1 4 8 8	24"		2			Same as above, wet

Well Contruction Summary



Depth scale: 5, 10, 15, 20

Job Name Great Bridge North Approach	Date Started 8/21/95	Drill Method HSA
Job Number 2978.002	Date Completed 8/21/95	Casing Diameter 2"
Client Name Army Corp of Engineers	Total Depth 14.28 Feet BEG	Screen Interval 3 to 15 Feet BEG
Location Great Bridge, Virginia	Water Level 4.90 Feet BEG	Slot Size 0.010
Boring Number MW-5/SB-14	Surface Elevation MSLD	Drilling Co. Connelly and Associates
Geologist Mike Bruzzesi	Signature	Date

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-15

Depth (ft)	Blows/6'	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
5	1 1 1 3	4"		18			Gray coarse to medium SANDS
	3 4 8 11	15"		20			Medium red/brown to gray coarse to medium SAND with medium SAND with organic matter and organic and sewage odors
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-15
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-16

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
5	1/1" 1 3	17		0			Dark brown coarse to medium SAND with some fines and organic material
10							
15							
20							

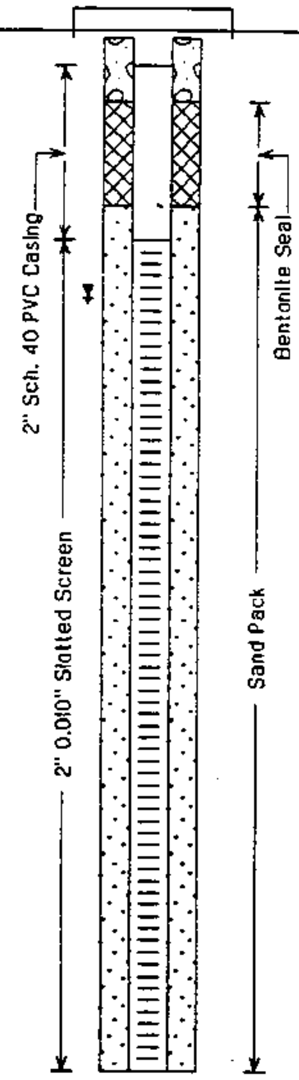
Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-16
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95

VERSAR, Inc.
Environmental Risk Management

Log of Boring MW-3/SB-17

Depth (ft)	Date	Time	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
0									Asphalt
4–6			1 1 1 2	18"	0				Medium brown coarse to fine SAND no odors
9–11			1 1 2 2	20"	0				Same as above, wet

Well Contruction Summary



Job Name: Great Bridge North Approach	Date Started: 8/21/95	Drill Method: HSA
Job Number: 2978.002	Date Completed: 8/21/95	Casing Diameter: 2"
Client Name: Army Corp of Engineers	Total Depth: 14.30 Feet BEG	Screen Interval: 3 to 15 Feet BEG
Location: Great Bridge, Virginia	Water Level: 3.88 Feet BEG	Slot Size: 0.010
Boring Number: MW-3/SB-17	Surface Elevation: MSLD	Drilling Co.: Connelly and Associates
Geologist: Mike Bruzzesi	Signature:	Date:

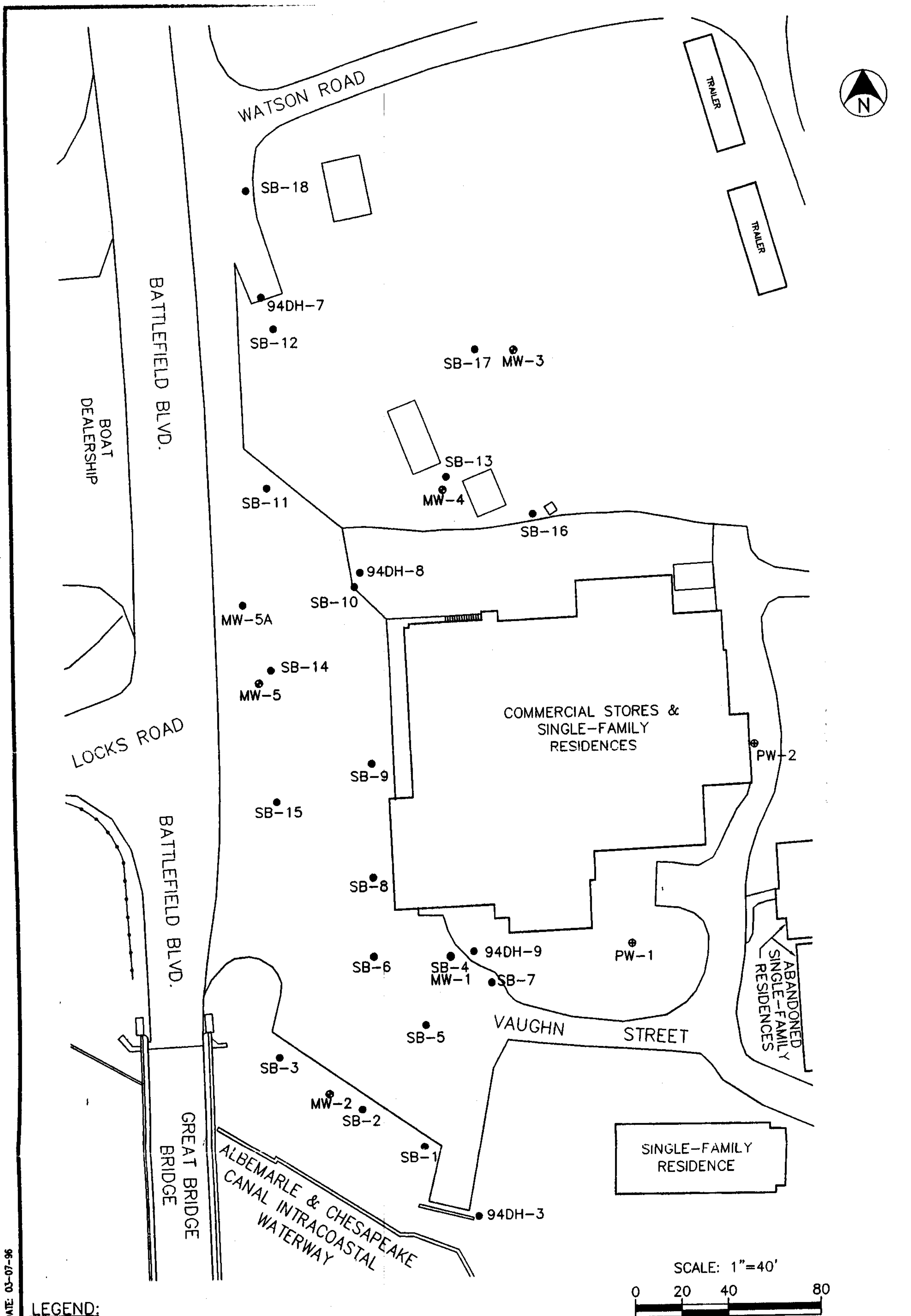
VERSAR, Inc.
Environmental Risk Management

Log of Boring SB-18

Page 1 of 1

Depth (ft)	Blows/6"	Advanced/ Recovered	Sample Number	PID (ppm)	Sample Interval	USCS Symbols	Lithologic Description
							Asphalt
5	1 1 1 3	18		0			Medium gray coarse to medium SAND, wet. No odors
10							
15							
20							

Job Name Great Bridge North Approach
Depth to Water
Job Number 2978.002
Signature
Client Name Army Corp of Engineers
Drill Method HSA
Boring Number SB-18
Date Completed 8/21/95
Geologist Mike Bruzzesi
Date 8/21/95



LEGEND:

- ⊗ GROUNDWATER MONITORING WELL
- ⊕ POTABLE GROUNDWATER WELL
- ● SOIL TEST BORING

ARM\2976-002\9601-503.DWG PLOT DATE: 03-07-96

SOIL TEST BORING AND GROUNDWATER MONITORING WELL LOCATION MAP			
DESIGNED BRUZZESI	DATE 01/02/96	ARMY CORPS GREAT BRIDGE BRIDGE (NORTH APPROACH) CHESAPEAKE, VA	
LASSITER LASSITER	01/11/96		
Versar INC. 6850 VERSAR CENTER SPRINGFIELD, VIRGINIA 22151 (703) 750-3000		PROJECT NO. 2976-002	SCALE: AS SHOWN
		DRAWING NO. 9601-503	FIGURE 3

North Side

Versar INC

Table 1
Groundwater Measurement Data

Great Bridge Bridge-North Approach Site
U.S. Army Corps of Engineers
Chesapeake, Virginia

Location	Date	Top of Casing Elevation (ft.)	Depth to Groundwater (ft.)	Groundwater Elevation (ft.)
MW-1	9/7/95 11/10/95	8.63	4.94 5.12	3.69 3.51
MW-2	9/7/95 11/10/95	7.49	3.81 4.22	3.68 3.27
MW-3	9/7/95 11/10/95	7.38	4.31 3.49	3.07 3.89
MW-4	9/7/95 11/10/95	8.37	4.69 4.54	3.68 3.83
MW-5	9/7/95 11/10/95	8.46	4.77 4.73	3.69 3.73

NOTE: Groundwater elevations relative (based on an assumed bench-mark of 15 ft.).

Note: The assumed benchmark elevation is approximately 2 feet above actual, i.e. table elevation values are high [illegible] 30Aug02

South Side

Versar INC

Table 1
Groundwater Measurement Data

Great Bridge Bridge Site
U.S. Army Corps of Engineers
Chesapeake, Virginia
DEQ-PC #93-0247

Location	Date	Top of Casing Elevation (ft.)	Depth to Groundwater (ft.)	Groundwater Elevation (ft.)
94GBW-1	9/14/94 5/8/95	4.77	1.70 2.72	3.07 2.05
94GBW-2	9/15/94 5/8/95	5.78	2.40 3.42	3.38 2.36
94GBW-3	9/14/94 5/8/95	4.65	1.50 2.60	3.15 2.05

NOTES:

Groundwater elevations relative (based on an assumed bench-mark of 5.78 ft.).

Note: The assumed benchmark elevation is approximately 1.4 feet above actual, i.e. table elevation values are high.

[illegible]
30 Aug 02

SECTION 02210
SUBBASE
10/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T 205	Density of Soil In-Place by the Rubber-Balloon Method
AASHTO T 238	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods
AASHTO T 239	Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1	(1996) Safety and Health Requirements

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(January 1994) Road and Bridge Specifications
VTM-1	Laboratory Determination of Theoretical Maximum Density and Optimum Moisture Content of Soils, Granular Subbase and Base Materials
VTM-7	Atterberg Limits
VTM-8	Conducting California Bearing Ratio Tests
VTM-25	Dry Preparation and Mechanical Analysis of Soils

1.2 MATERIALS

Material shall conform to the requirements of VDOT RBS Section 208 except where other types of aggregate material are specified in the Contract, in which case the applicable specifications governing the material shall apply.

1.3 SUBMITTALS

Government approval is required for submittals with a 'GA" designation; submittals having an 'FIO designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS PROCEDURES:

SD-09 Reports

Soils Compaction Tests; GA.
Tolerance Tests for Subgrade; GA.

The Contractor's testing laboratory shall submit three copies of all laboratory and field test reports directly to the Contracting Officer within 48 hours of the completion of the test. Required soils tests for fill, backfill, and subgrade materials shall be submitted prior to beginning fill and backfill operations.

1.4 DESCRIPTION

This work shall consist of furnishing and placing one or more courses of mineral aggregate on a prepared subgrade in accordance with the requirements of these specifications and in reasonably close conformity with the lines, grades, typical sections, and cross sections shown on the plans or as established by the Contracting Officer.

PART 2 PRODUCTS

Materials for Select Material, Type II shall conform to the requirements of Virginia Department of Transportation Road and Bridge Specifications (VDOT RBS), Section 207. Select Material, Type I shall conform to the requirements of Virginia Department of Transportation test procedures presented in VTM-7, VTM-8, AND VTM-25. Select Material, Type I, hereinafter also referred to as select borrow, shall be CBR-20 minimum.

PART 3 EXECUTION

The work conducted under this section shall be coordinated and accomplished, at a minimum, in accordance with requirements specified in SECTION 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST), EM 385-1-1, and the Contract Drawings.

3.1 PROCEDURES

Prior to placement of the subbase course, the subgrade shall be constructed in accordance with the requirements of the applicable provisions of Section 02225.

Where the required thickness is more than 6 inches, the material shall be spread and compacted in two or more layers of approximately equal thickness. The compacted thickness of any one layer shall be not more than 6 inches.

Subbase shall be placed in successive uniform layers not exceeding 6 inches. Before placing, material shall be moistened or aerated, including material that is unsatisfactory due solely to excess moisture, as necessary to obtain specified compaction. The density of each layer of subbase material, when compared to the laboratory maximum density as determined in accordance with the requirements of VTM-1, shall conform to the following:

% Material Retained on No. 4 Sieve	Min. % Density
0-50	100
51-70	95

Percentages will be reported to the nearest whole number.

Not more than one sample in every five shall have a density less than that specified, and the density of such a sample shall be not more than 2 percent below that specified.

If the surface of the subbase becomes uneven or distorted and sets up in that condition, it shall be scarified, reshaped, and recompacted. If the subbase when compacted and shaped shows a deficiency in thickness or if depressions occur in the surface, the Contractor shall scarify such sections at his own expense before additional material is added.

Field density determinations shall be performed in accordance with the requirements of AASHTO T 191, AASHTO T 205, or AASHTO T 214; modified to include material sizes used in the laboratory determination of density; with a portable nuclear field density testing device; or by other approved methods. When a nuclear device is used, density determinations for embankment material shall be in accordance with 3.3, SOILS TESTS, herein.

3.2 BORROW MATERIAL

Borrow materials shall be obtained from sources outside the limits of Government controlled land. The source of borrow material shall be the Contractor's responsibility. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expense of developing the sources, including rights-of-way for hauling.

Borrow materials shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Borrow materials shall be subject to approval. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

3.3 SOILS TESTS

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation and Atterberg limits shall be made in accordance with the procedures referenced in VTM-1, VTM-25, and VTM-7. Field tests for density and moisture content shall be made in accordance with AASHTO T 191, AASHTO T 205, or AASHTO T 214 except that method AASHTO T 238 may be used to supplement tests by method AASHTO T 191. When AASHTO T 238 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in AASHTO T 191. AASHTO T 238 results in a wet unit weight of soil and when using this method, AASHTO T 239 shall be used to determine the moisture content of the soil. When soil conditions exist which produce inconsistent results by the nuclear gauge method AASHTO T 238, only method AASHTO T 191 shall be used. Where results by method AASHTO T 238 differ from those by method AASHTO T 191, the results by method AASHTO T 191 shall govern for contract compliance.

The following tests are required:

a. A minimum of one moisture-density test shall be performed for each classification of fill material backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six-nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

Field density tests shall be performed as follows: A minimum of one test per lift per 100 feet of sidewalk or fraction thereof is required for fill material. A minimum of one test per lift per 350 square yards or fraction thereof is required for fill material. A minimum of one test per 500 square yards or fraction thereof is required for compacted ground surfaces prior to filling. Locations of all tests shall be at the direction of the Contracting Officer.

3.4 TOLERANCES

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.

3.4.1 Smoothness

Surface of each layer shall show no deviations in excess of 3/8 inch when tested with 10-foot straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material or by reworking existing material and compacting, as required.

Measurements for deviation from grade and cross section shown shall be taken in successive portions parallel to the road centerline with a 10-foot straightedge. Measurements shall also be taken perpendicular to the road centerline at 15-foot intervals.

3.4.2 Thickness

Compacted thickness of the base course shall be within ½ inch of the thickness indicated. Where the measured thickness is more than ½ inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than ½ inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within ¼ inch of the thickness indicated.

Thickness of the base course shall be measured in intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

-- End of Section --

SECTION 02220

DEMOLITION
12/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CITY OF CHESAPEAKE

PFM	Public Facilities Manual - Volume 1-111

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual

1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from the project site daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer and removed in a timely manner. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.2.1 Utility Demolition Notes

Utility demolition notes appearing on the contract drawings apply to all work associated with abandonment and protection of public utility systems. All work shall be in accordance with the City of Chesapeake Public Facilities Manual (PFM).

1.2.2 Bridge Contractor Demolition

The Bridge Contractor will demolish and remove rubbish and debris from their operations. Items to be demolished include buildings and other bridge related items shown on the contract drawings as removed by others excluding utilities.

1.2.3 Roadway Contractor Demolition

The Roadway Contractor shall demolish, salvage items from the existing bridge, and remove rubbish and debris from their operations. Items to be demolished include, but are not limited to, specified buildings, including the Operator's House, the culvert bridge, the roadway, the swing bridge, and items except for those indicated to be salvaged on the existing swing bridge, which are shown on the contract drawings.

An electronic copy of the Swing Span Bridge is attached to the Bid Documents.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-08 Statements

Work Plan; GA. Shoring/Bracing System; GA.

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

SD-18 Records

Records of Existing Conditions; FIO.

A video survey, displaying a visible time and date record, shall be filed with the Contracting Officer prior to the commencement of anyland disturbing activities including, but not limited to, excavation or demolition. The survey shall include all features/items/structures that could possibly be affected by the Contractor's activities. Readings and observations shall be taken daily and included with the Contractor's daily inspection report.

The work conducted under this section shall be coordinated and accomplished in accordance with the requirements specified in Section 02362 PRESTRESSED CONCRETE PILING.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, of lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. The Contractor shall obtain the services of a registered Professional Engineer for the design of all shoring and bracing systems that are required to protect the structural integrity of the existing buildings.

1.5.4 Protection of Trees, Shrubs, Groundcovers, and Wetlands

Trees, shrubs, groundcovers, and wetlands within the project site which might be damaged during demolition, and which are indicated to be left in place, shall be protected by a 6 foot high fence. The fence shall be securely erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

1.5.5 Environmental Protection

The work shall comply with the requirements of Section 01560 ENVIRONMENT PROTECTION, Section 13281 ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS, and Section 13283 REMOVAL AND DISPOSAL OF LEAD CONTAINING PAINT.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

1.8 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the approved work plan.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

The work conducted under this Section shall be coordinated and accomplished in accordance with requirements specified in Section 01560 ENVIRONMENT PROTECTION, Section 02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL, Section 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST),Section 13281 ENGINEERING CONTROL OF ASBESTOS CONTAINING MATERIALS, Section 13283 REMOVAL AND DISPOSAL OF LEAD CONTAINING PAINT, and CONTRACT DRAWING B-7.

3.1 EXISTING STRUCTURES

Existing structures indicated shall be removed completely. Sidewalks, curbs, gutters and street light bases shall be removed as indicated.

3.2 UTILITIES

Disconnection of utility services, with related meters and equipment, are being performed by others. Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section 02221 EARTHWORK.

3.4 Shattering

Bridge demolition shall be accomplished to the furthest extent practicable by non-shattering methods. Shattering means any method which would scatter debris. "Hoe-Ram" or other comparable tools may be used in such as fashion that fractures but does shatter and scatter bridge components into the water. Components that fall into the water must be picked up before the next component is demolished or before the channel is opened to traffic, whichever event comes first.

3.5 DEMOLITION OF SWING SPAN BRIDGE

a. The Contractor shall consider the close proximity of the two bridges in determining the effort and methods required to perform demolition activities.

b. The existing swing span bridge shall remain operational until the deck sections are removed.

c. Existing swing bridge spans shall be removed within 14 days after traffic is shifted onto the new bridge.

d. The Contractor will be allowed 2 complete closures (3 days each) and 3 partial closures of the AIW Canal for all demolition and construction work per Specification Section 01005. Refer to Specification Section 01005 for additional information and associated requirements including coordination with the U.S. Coast Guard, the Bridge Contractor, and the City of Chesapeake.

e. The Contractor will be allowed to close Battlefield Boulevard between stations 20+00 and 27+00 for 1 - 7 day period to remove the swing spans. Prior to the road closure, the Contractor shall employ necessary traffic control measures and institute the detour plan. Battlefield Boulevard shall remain open to traffic at all other times.

f. Closure of Battlefield Boulevard for swing bridge demolition shall not coincide with allowable closures for culvert bridge work.

g. Contractor shall work 24 hours per day for the duration of bridge and/or channel closures. Refer to Specification Section 01005 for restrictions.

h. All 20-inch square piles shall be removed except those indicated to be demolished in place. All 20-inch square piles that are indicated to be demolished in place shall be demolished to 1 foot below the mudline.

i. All wood piles shall be demolished to 4 feet below existing grade.

j. Demolition of the swing span bridge shall include, but not be limited to, foundations, pivot piers, bridge operator's house, abutments, and utility disconnections.

k. Contractor shall submit demolition plan and traffic control plan in accordance with Specification Section 01005 prior to start of demolition activities.

3.6 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.6.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.6.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.6.1.2 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents. The following items reserved as property of the Government shall be delivered to the areas designated.

List of existing Great Bridge Bridge equipment to be salvaged by the Contractor and delivered to the Great Bridge Reservation:

a. All Traffic Signals.
b. All Traffic Gates and Stands.
c. All Wedges and Lock Bars.
d. All Span Limit Switches.
e. All Wedges Limit Switches.
f. All Motor and Braking Systems.

    (1) 2 Wedge Motors
    (2) 2 Turn Motor Brakes
    (3) 2 Span Motors
    (4) 2 Wedge Motor Brakes

g. Transfer Switch.
h. All Neon "Flashing Signs".
i. All Navigation Lights.
j. All Control Relays in Cabinets.
k. All Circuit Breakers.
l. All Resistors.
m. All Space Heaters.
n. Spot Light.
o. All Indicating Lights and Push Buttons.
p. Turning Motor Track. One Span.
q. Generator.

3.6.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be properly disposed of in a Commonwealth of Virginia permitted sanitary landfill facility that has been approved by the Contracting Officer.

3.7 CLEAN UP

Debris and rubbish shall be removed from all work and material storage areas daily. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply. All vehicles for hauling debris shall be covered.

3.8 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings. Estimated average depth of pavement is 12".

-- End of Section --

SECTION 02221
EARTHWORK

10/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2487	(1990) Classification of Soils For Engineering Purposes

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T 205	Density of Soil In-Place by the Rubber-Balloon Method
AASHTO T 238	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods
AASHTO T 239	Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1	(1996) Safety and Health Requirements

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(January 1994) Road and Bridge Specifications
VESCH	Virginia Erosion and Sediment Control Handbook
VTM-1	Laboratory Determination of Theoretical Maximum Density and Optimum Moisture Content of Soils, Granular Subbase and Base Materials
VTM-7	Atterberg Limits

VTM-8	Conducting California Bearing Ratio Tests
VTM-25	Dry Preparation and Mechanical Analysis of Soils, Select Material, Subbases and Aggregate Bases

1.2 DEFINITIONS

This work shall consist of constructing roadway earthwork in accordance with the requirements of these specifications and in reasonably close conformity with the specified tolerances for the lines, grades, typical sections, and cross sections shown on the plans or as established by the Contracting Officer. Earthwork shall include regular excavation and borrow material; constructing embankments; disposing of surplus and unsuitable material; shaping; compacting; sloping; dressing; and temporary erosion control work.

1.2.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GM, GP, SW, SP, and SP-SM are satisfactory under roadways, entrances, curb and gutter, and within two feet beyond the of the edge of pavement or back of curb. Materials classified by ASTM D 2487 as GW, GP, SW, SP, or SP-SM are satisfactory as backfill for in-situ or backfill for trenches except in areas where special materials are shown on the plans. Materials classified by ASTM D 2487 as GW, GM, GP, GM, GC, SW, SP, SM, SC, ML, and CL are satisfactory in all other areas. The above listed materials plus MH and CH are satisfactory in-situ.

1.2.2 Unsatisfactory Materials

Materials classified by ASTM D 2487 as OL, OH and PT are unsatisfactory in-situ and as any kind of fill.

Unsatisfactory materials also include materials containing roots and other organic particles greater than four inches in diameter, stones and rubble greater than six inches, trash, debris, frozen materials, other deleterious material, and material which cannot support equipment or be properly compacted due to excess moisture.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP.

Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are non-plastic.

1.2.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the appropriate test procedure presented in VTM-1, abbreviated hereinafter as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a 'GA" designation; submittals having an 'FIO designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS PROCEDURES:

SD-09 Reports

Soils Tests; GA.

The testing laboratory shall submit three copies of all laboratory and field test reports directly to the Contracting Officer within 48 hours of the completion of the test. Required soils tests for fill, backfill, and subgrade materials shall be submitted prior to beginning fill and backfill operations.

SD-13 Certificates

Temporary silt fences, geotextile fabric silt barriers, and filter barriers ; GA

Geotextile fabric shall be tested by an independent commercial laboratory to verify the material requirements specified in PART 2 PRODUCTS. The contractor shall provide written documentation of all tests specified. Documentation shall include style, lot, roll numbers and actual results of each test. In addition, the name, phone number of the testing laboratory and date of testing shall be provided.

1.4 SUBSURFACE DATA

Subsurface soil boring logs are attached to Section 01055 SOIL BORING DATA. The subsoil investigation report may be examined at the Norfolk District. These data represent the best subsurface information available.

PART 2 PRODUCTS

Materials for Select Material, Type I shall conform to the requirements of Virginia Department of Transportation Road and Bridge Specifications (VDOT RBS), Section 207. Select Material, Type I shall conform to the requirements of Virginia Department of Transportation test procedures presented in VTM-7, VTM-8, AND VTM-25. Select Material, Type I, hereinafter also referred to as select borrow, shall be CBR-20 minimum.

Materials for temporary silt fences, geotextile fabric silt barriers, and filter barriers shall conform to the requirements of Virginia Department of Transportation Road and Bridge Specifications (VDOT RBS), Sections 242 and 245.

PART 3 EXECUTION

The work conducted under this section shall be coordinated and accomplished in accordance with requirements specified in SECTION 02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL, SECTION 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST), EM 385-1-1, and the Contract Drawings.

Where required, surface ditches shall be cut on the top of slopes of excavation or at the foot of slopes of embankment and at such other points not necessarily confined to the right of way or shown on the plans and shall be of such dimensions and grades as directed by the Contracting Officer.

Allaying dust shall be performed in accordance with the requirements of VDOT RBS Section 511.

Prior to the beginning of excavation, grading, and embankment operations in any area, necessary clearing and grubbing in that area shall have been performed in accordance with the requirements of Section 02230 CLEARING AND GRUBBING.

3.1 EROSION AND SILTATION CONTROL

Erosion and siltation shall be controlled through the use of the devices and methods specified herein and as specified in the VESCH or as is otherwise necessary. The Contracting Officer reserves the right to require other temporary measures not specifically described herein to correct an erosion or siltation condition.

Erosion and siltation control devices and measures shall be maintained in a functional condition at all times. Temporary and permanent erosion and sedimentation control measures shall be inspected after each-rainfall and at least daily during periods of prolonged rainfall. Deficiencies shall be immediately corrected. The Contractor shall make a daily review of the location of silt fences and filter barriers to ensure that they are properly located for effectiveness. Where deficiencies exist, corrections shall be made immediately as approved or directed by the Contracting Officer.

When sediment reaches approximately 1/2 the volume capacity of the device, sediment deposits shall be removed or additional devices constructed as approved or directed by the Contracting Officer. Removed sediment shall be disposed of in accordance with the requirements of VDOT RBS Section 106.04. Sediment deposits remaining in place after the device is no longer required shall be dressed to conform with the existing grade, prepared, and seeded in accordance with the requirements of VDOT RBS Section 603.

Geotextile fabric that has decomposed or becomes ineffective and is still needed shall be replaced. In addition, temporary erosion and sediment control devices shall be removed within 30 days after final site stabilization or after the temporary devices are no longer needed as determined by the Contracting Officer.

a. Earth Berms and Slope Drains: The top of earthwork shall be shaped to permit runoff of rainwater. Temporary earth berms shall be constructed and compacted along the top edges of embankments to intercept runoff water. Temporary slope drains shall be provided to intercept runoff and adequately secured to prevent movement. Slope drains may be flexible or rigid but shall be capable of being readily shortened or extended. A portable flume shall be provided at the entrance to temporary slope drains.

b. Incremental Seeding: Cut and fill slopes shall be shaped, and topsoil seed, and mulch shall be applied in accordance with the requirements of SECTION 02935 TURF as the work progresses in the following sequence:

1. Slopes whose vertical height is less than 20 but more than 5 feet shall be seeded in two equal increments.

2. Slopes whose vertical height is 5 feet or less may be seeded in one operation.

Seeding operations shall be initiated within 48 hours after attaining the appropriate grading increment or upon suspension of grading operations for an anticipated duration of greater than 15 days or upon completion of grading operations for a specific area.

c. Check Dams and Silt Settlement Boxes: As an initial item of work, required check dams shall be constructed at 25 foot intervals below the outfall end of drainage structures.

Straw check dams shall not be constructed in streams and shall be installed only where designated on the plans to form settlement pools. Settlement pools shall be cleaned regularly as directed by the Contracting Officer, and material removed shall be transported and deposited at locations where it will not reenter the stream or drainage ways.

d. Baled Straw Silt Barriers: Baled straw silt barriers may be substituted for temporary filter barriers with the approval of the Contracting Officer in noncritical areas, such as pavement locations where filter barriers cannot be installed in accordance with the plans and the requirements of the specifications, locations where the runoff velocity is low, and locations where the Contracting Officer determines that streams and water beds will not be affected.

e. Temporary Silt Fences, Geotextile Fabric Silt Barriers, and Filter Barriers:

1. Temporary silt fences: Fences shall be erected at locations shown on the plans or determined by the Contracting Officer. Extra-strength geotextile fabric or standard-strength geotextile fabric with wire fence reinforcement shall be provided. Posts shall not be spaced more than 10 feet apart Posts shall be uniformly installed with an inclination toward the potential silt load area of at least 2 but not more than 20 degrees. Attaching fabric to existing trees will not be permitted.

Fabric shall be firmly secured to the post or wire fence. The bottom of the fabric shall be entrenched in the ground at least 4 inches. Fabric may be spliced only at support posts and with an overlap of at least 6 inches. The top shall be installed with a 1-inch tuck or reinforced top end section. The height of the finished fence shall be a nominal 35 inches.

2. Geotextile fabric silt barriers: Existing fences or brush barriers used along the downhill side of the toe of fills or below pipe culvert installations shall have standard-strength geotextile fabric attached at specified locations. The bottom of the fabric shall be entrenched in the ground at least 4 inches, and the top shall be installed with a 1-inch tuck or reinforced top end section.

3. Temporary filter barriers: Barriers shall consist of standard-strength geotextile fabric or 10-ounce burlap fabric and shall be securely fastened to wood or metal supports that are spaced at not more than 3-foot intervals and driven at least 12 inches into the ground. At least three supports shall be used. The bottom of the fabric shall be entrenched in the existing ground at least 4 inches. The temporary filter barrier shall be at least 15 but not more than 18 inches in height. The top of the fabric shall be installed with a 1-inch tuck or reinforced top end section.

Temporary filter barriers shall be installed in ditch lines and at temporary locations as directed or approved by the Contracting Officer where construction changes the earth contour and drainage runoff.

f. Sediment basins: Sediment basins are required if runoff from a watershed area of three acres or more flows across a disturbed area.

3.2 DRAINAGE AND DEWATERING

3.2.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.2.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously at least 2 feet below the working level, or deeper as required to continue construction.

3.3 CLEARING AND GRUBBING

Clearing and grubbing is specified in Section 02230 CLEARING AND GRUBBING.

3.4 TOPSOIL

Topsoil shall be stripped to full depth below existing grade within the designated excavations and grading lines and deposited in storage piles for later use.

Topsoil stockpiled for later use in the work shall be stored within the right of way unless the working area is such that the presence of the material would interfere with orderly prosecution of the work. Stockpile areas outside the right of way shall be located by the Contractor at his expense. Topsoil used in the work shall be removed first from stockpiles located on private property. Surplus topsoil remaining on private property after completion of topsoiling operations shall be moved onto the right of way and stockpiled, shaped, and seeded as directed by the Contracting Officer.

Stripping topsoil shall be confined to the area over which excavation is to be actively prosecuted within 15 days following the stripping operation. Excavation and embankment construction shall be confined to the minimum area necessary to accommodate the Contractor's equipment and work force engaged in the earth moving work.

Areas outside the building lines from which topsoil has been removed and areas indicated shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 2 inches by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted as specified in Section 02935 TURF. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

Areas within 5 feet outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.5 EXCAVATION

Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. Payment therefore will be made in conformance with the CHANGES clause of the CONTRACT CLAUSES, except for soil that becomes unsatisfactory due to the action or inaction of the Contractor in the performance of his work. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials. Satisfactory material shall be placed and compacted as specified in accordance with 3.11, EMBANKMENTS, herein. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be properly disposed of off the Project Site.

3.6 REGULAR EXCAVATION

Regular excavation shall consist of removing and disposing of material located within the construction limits, including widening cuts and shaping slopes necessary for preparing the roadbed; removing root mat; stripping topsoil; cutting ditches, channels, water-ways, intersections, approaches, and entrances; and performing other work incidental thereto. The Contracting Officer may require materials in existing pavement structures to be salvaged for use in traffic maintenance.

Underground tanks, existing foundations, and slabs located within the construction limits shall be removed and disposed of in a location approved by the Contracting Officer. In lieu of removal, foundations and slabs located 3 feet or more below the proposed subgrade may be broken into particles not more than 18 inches in any dimension and reoriented to break the shear plane and allow for drainage.

Undrained areas shall not be left in the surface of the roadway. Excavation operations shall be conducted so that material outside limits of slopes shall not be disturbed.

3.7 BORROW MATERIAL

Borrow materials shall be obtained from sources outside the limits of Government controlled land. The source of borrow material shall be the Contractor's responsibility. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expense of developing the sources, including rights-of-way for hauling. Borrow shall not be used until all excavation has been placed in the embankments.

Borrow materials shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Borrow materials shall be subject to approval. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

3.8 REMOVING UNSATISFACTORY MATERIAL

Where excavation to the finished graded section results in a subgrade or slopes of unsatisfactory material, such material shall be excavated below the grade shown on the plans or as directed by the Contracting Officer. Areas so excavated shall be backfilled with approved material in accordance with the requirements of 3.09, BACKFILL FOR REPLACING UNSATISFACTORY MATERIAL, herein.

Excavation for structures shall be carried to foundation materials satisfactory to the Contracting Officer regardless of the elevation shown on the plans. Excavated material, if suitable, shall be used for backfilling around the structure or constructing embankments.

Unsatisfactory material shall be disposed of in accordance with the requirements of VDOT RBS Section 106.04 for unsuitable material.

3.9 BACKFILL FOR REPLACING UNSATISFACTORY MATERIAL

Backfill shall be regular or borrow excavation or select or bridging material as directed by the Contracting Officer. Backfilling operations shall be performed in accordance with the requirements of 3.10, BACKFILLING OPENINGS MADE FOR STRUCTURES, herein.

3.10 BACKFILLING OPENINGS MADE FOR STRUCTURES

Backfilling shall be a part of the excavation, although the Contracting Officer may require that backfill material be obtained from a source within the construction limits entirely apart from the structure. The opening to be backfilled shall be dewatered performed in accordance with the requirements of 3.2, DRAINAGE AND DEWATERING, herein prior to backfllling. Backfill shall not be placed against or over cast-in-place box culverts or other structures until the top concrete slab section(s) has been in place 14 days, exclusive of days on which the average high-low ambient temperature is below 40EF in the shade or until the concrete control cylinder(s) has attained a compressive strength equal to 93 percent of the 28 day design compressive strength.

Backfill shall be compacted in horizontal layers not more than 6 inches in thickness, loose measurement. Backfill shall be placed in horizontal layers such that there will be a horizontal berm of compacted undisturbed material behind the structure for a distance at least equal to the remaining height of the structure or wall to be backfilled. Backfill shall be placed in a manner to deter impoundment of water and facilitate existing drainage. Backfill around piers in areas not included in the roadway prism shall be constructed in uniformly compacted layers.

Where embankment can be deposited on only one side of abutments, wingwalls, sheetpile, or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning or excessive pressure against the structure. When embankment is to be placed on both sides of a structure, operations shall be conducted so that the embankment is always at approximately the same elevation on both sides of the structure.

Openings subject to flooding shall be backfilled as soon as practicable or as directed by the Contracting Officer.

3.11 EMBANKMENTS

Construction shall consist of constructing roadway embankments, including preparing areas upon which they are to be placed; placing and compacting approved material within roadway areas where unsuitable material has been removed; and placing and compacting embankment material in holes, pits, utility trenches, and other depressions within the roadway area.

Embankment shall be constructed with approved material and shall be placed so as to be uniformly compacted throughout. Embankment shall not contain muck, frozen material, roots, sod, or other deleterious material. Embankment shall not be placed on frozen ground or areas covered with ice or snow.

Wherever sufficient right of way exists, surplus materials shall be used to widen embankments and flatten slopes as directed by the Contracting Officer.

Areas that will support compacting equipment shall be scarified and compacted to a depth of 6 inches to the same degree as the material to be placed thereon.

Place geotextile fabric for subgrade stabilization in accordance with specification Section 02225 Subgrade and Shoulders.

Embankment shall be placed in successive uniform layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors and 8 inches loose thickness for other than hand operated machines over the entire roadbed area. Before placing, material shall be moistened or aerated, including material that is unsatisfactory due solely to excess moisture, as necessary to obtain specified compaction. If sandy or other soils is encountered that will not compact readily, clay or other suitable material shall be added in such quantity as will permit compaction. The density shall be at least 95 percent of the laboratory maximum density as specified in the procedures of VTM-1.

Field density determinations shall be performed in accordance with the requirements of AASHTO T 191, AASHTO T 205, or AASHTO T 214; modified to include material sizes used in the laboratory determination of density; with a portable nuclear field density testing device; or by other approved methods. When a nuclear device is used, density determinations for embankment material shall be in accordance with 3.17, SOILS TESTS, herein.

As the compaction of each layer progresses, continuous leveling and manipulating will be required to ensure uniform density. Prior to placement of subsequent layers, construction equipment shall be routed uniformly over the entire surface of each layer or the layer shall be scarified to its full depth in the area where the equipment is routed.

Rock, broken concrete or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

The best material shall be reserved for finishing and dressing the surface of embankments. Work necessary to ensure the reservation of such material shall be the responsibility of the Contractor.

3.11.1 Retained Roadway Embankment

Roadway embankment retained by the new bulkhead in the vicinity of the culvert bridge shall be constructed as follows: Probing and necessary removal of existing erosion protection materials shall be performed in accordance with Contract Drawing Sheets D-1 and D-3. Prior to beginning backfill, the upper 24 inches of material existing at the bottom and along the slope below the mean low water elevation, shall be removed and disposed of as unsatisfactory material. Oversize material suitable for embankment foundation, encountered within this upper 24-inch zone, maybe left in place as approved by the Contracting Officer, provided that it does not interfere with construction of any required new work. Place non-woven geotextile fabric having an apparent openning size no larger than U.S. Sieve No. 70 against the full height and width of bulkhead sheeting, prior to placing embankment fill materials. Drainage, dewatering, and embankment fill shall be constructed as specified elsewhere in this specification section. At the Contractor's option, clean stone meeting VDOT Size No. 57 may be placed up to a maximum elevation of +3 feet, in 18-inch maximum lifts compacted with a minimum of 2 passes of a minimum 10-ton vibratory roller, and covered with geotextile fabric conforming to Specification Section 02225 prior to continuing with embankment fill as specified. Selection and placement of embankment materials, shall fully consider the sequencing and installation requirements of all new work, including but not limited to installation of concrete pilings, soil anchors, sheet pilings, and tie rods.

3.12 TOLERANCES

a. Finished grade of top of earthwork shall be 0.10 foot above or below the theoretical grade.

b. Slopes shall be graded in the following manner:

1. Earth excavation slopes:

    a. Slopes steeper than 2:1 shall be grooved in accordance with the standard drawings and shall not deviate from the theoretical plane surface by more than 0.5 foot.

    b. Slopes steeper than 3:1 up to and including 2:1 shall be rough graded in a manner to provide horizontal ridges and grooves having an average deviation of 6 to 12 inches from the theoretical line of the typical cross section as is accomplished by the normal operation of heavy grading equipment.

    c. Slopes 3:1 or flatter shall be uniformly finished and shall not deviate from the theoretical plane surface by more than 0.5 foot.

2. Earth embankment slopes:

a. Slopes steeper than 3:1 shall not deviate from the theoretical plane slope by more than 0.5 foot and shall be rough graded in a manner to provide horizontal ridges and grooves not more than 0.5 foot from the theoretical line of the typical cross section as is accomplished by the normal operation of heavy grading equipment.

b. Slopes 3:1 and flatter shall be uniformly finished and shall not deviate from the theoretical plane surface by more than 0.5 foot.

3.13 BLASTING

Blasting will not be permitted.

3.14 SHORING

Shoring, including sheet piling, shall be furnished and installed in accordance with EM 385-1-1, Safety and Health Requirements, as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.15 COMPACTION FOR SIDEWALKS AND DRAINAGE TRENCHES BEYOND SUBGRADE

Each layer of fill, backfill, and prepared subgrade shall be compacted to not less than the percentage of maximum density specified below:

Percent Laboratory Maximum Density

	For Cohesive Material	For Cohesionless Material
Within 2' of back of curb & gutter and pavement	90	95
Greater than 2' beyond back of curb & gutter and pavement	85	90

Compacted surfaces that are disturbed by the Contractor's operations or adverse weather shall be scarified and re-compacted as specified at the Contractor's expense prior to further construction thereon.

3.16 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Structures shall bear on undisturbed natural subgrade or on compacted fill. Subgrade which becomes disturbed below indicated grade shall be over-excavated and backfilled, as directed, with VDOT RBS Size No. 57 or No. 21A Stone at the Contractor's expense.

3.17 SOILS TESTS

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation and Atterberg limits shall be made in accordance with the procedures referenced in VTM-1, VTM-25, and VTM-7. Field tests for density and moisture content shall be made in accordance with AASHTO T 191, T 205, or T 214 except that method AASHTO T 238 may be used to supplement tests by method AASHTO T 191. When AASHTO T 238 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in AASHTO T 191. AASHTO T 238 results in a wet unit weight of soil and when using this method, AASHTO T 239 shall be used to determine the moisture content of the soil. When soil conditions exist which produce inconsistent results by the nuclear gauge method AASHTO T 238, only method AASHTO T 191 shall be used. Where results by method AASHTO T 238 differ from those by method AASHTO T 191, the results by method AASHTO T 191 shall govern for contract compliance.

The following tests are required:

a. A minimum of one moisture-density test shall be performed for each classification of fill material backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six-nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. Field density tests shall be performed as follows: A minimum of one test per lift per 100 feet of sidewalk or fraction thereof is required for fill material. A minimum of one test per lift per 350 square yards or fraction thereof is required for fill material. A minimum of one test per 500 square yards or fraction thereof is required for compacted ground surfaces prior to filling. Locations of all tests shall be at the direction of the Contracting Officer.

3.18 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.

-- End of Section --

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1990) Classification of Soils for Engineering Purposes
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988) Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

U.S. ARMY CORPS OF ENGINEERS (COE)

EM 385-1-1	(1996) Safety and Health Requirements Manual

CITY OF CHESAPEAKE

PFM	Public Facilities Manual Volume I-III

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(January 1994) Road and Bridge

Specifications

VDOT S	(2001) Road and Bridge Standards

1.2 DEFINITIONS

1.2.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GP, SW, SP, or SP-SM are satisfactory in-situ and as final backfill.

1.2.2 Unsatisfactory Materials

Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Materials classified by ASTM D 2487 as OL, OH, and Pt are unsatisfactory in-situ. The above listed materials plus CH and MH are unsatisfactory as any kind of fill. Unsatisfactory materials also include those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than 3 inches in any dimension. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

1.2.4 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

1.2.5 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.6 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the appropriate procedure presented in ASTM D 1557, abbreviated hereinafter as percent maximum density.

1.3 SUBSURFACE DATA

Subsurface soil boring logs are attached to Section 01055 SOIL BORING DATA. The subsoil investigation report and samples of materials taken from subsurface investigations may be examined at the Norfolk District. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09, Reports

Soils Tests; FIO.

Testing of Backfill Materials; FIO.

The testing laboratory shall submit three copies of all laboratory and field test reports directly to the Contracting Officer within 48 hours of the completion of the test. Required soils tests for fill, backfill, and subgrade materials shall be submitted prior to beginning backfill and compaction operations.

PART 2 PRODUCTS

2.1 SELECT MATERIAL FOR BACKFILL - UNDER OR WITHIN 5' OF ROADWAY

Materials for Select Material, Type II shall conform to the requirements of Virginia Department of Transportation Road and Bridge Specifications (VDOT RBS), Section 207. Select Material, Type I shall conform to the requirements of Virginia Department of Transportation test procedures presented in VTM-1, VTM-7, VTM-8, and VTM-25, as applicable and in accordance with the City of Chesapeake PFM. Select Material, Type II, hereinafter also referred to as select borrow, shall be CBR-20 minimum.

2.2 SELECT MATERIAL FOR BACKFILL - OPEN AREAS

Initial backfill shall consist of select material Type II or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. Select material shall contain not more than 30% by weight of material passinge No. 200 mesh sieve. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 3 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.3 PIPE BEDDING MATERIAL

Pipe bedding material shall conform to the requirements of the City of Chesapeake PFM, the VDOT S and VDOT RBS.

2.4 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6-inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

The work conducted under this section shall be coordinated and accomplished in accordance with requirements specified in SECTION 02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL, SECTION 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST), and Contract Drawing B-7.

All work shall conform to the PFM except as modified by the Contract Drawings and/or specifications. In the event that there are conflicts between the specifications and the PFM, the PFM will govern on utilities owned by the City.

3.1 DRAINAGE AND DEWATERING

3.1.1 Drainage

Surface water shall be directed away from excavation and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.

3.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, the water level shall be maintained continuously below the working level.

3.2 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph "MATERIALS." Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph "BACKFILLING AND COMPACTION" at no additional cost to the Government.

3.2.1 Trench Excavation

The trench shall be excavated in accordance with the safety criteria of EM 385-1-1 and the recommendation of the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls below the top of pipe shall be made vertical. Trench walls shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in accordance with EM 385-1-1. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter and shall not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.2.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.2.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed as directed to the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION. Payment therefore will be in conformance with the CHANGES clause of the CONTRACT CLAUSES.

3.2.1.3 Removal of Unsatisfactory and Unstable Materials

Where unsatisfactory or unstable materials are encountered in the bottom of the trench, such materials shall be removed to the depth directed and replaced to the proper grade with suitable materials as provided in paragraph BACKFILLING AND COMPACTION. Payment therefore will be in conformance with the CHANGES clause of the CONTRACT CLAUSES. When removal of unstable material is required due to action or inaction of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.2.2 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.2.3 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.4 Stockpiles

Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment. Excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.3 BORROW MATERIAL

Borrow material shall be selected to meet requirements and conditions of the particular fill for which it is to be used. Borrow materials shall be subject to approval. Necessary clearing, grubbing, disposal of debris, and satisfactory drainage of borrow pits shall be performed by the Contractor as incidental operations to the borrow excavation.

3.3.1 Selection

Borrow materials shall be obtained from sources outside the limits of Government-controlled land. The source of borrow material shall be the Contractor's responsibility. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, shall pay all royalties and other charges involved, and shall bear all the expense of developing the sources, including rights-of-way for hauling.

3.4 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Before placing, material shall be moistened or aerated, including material which is unsatisfactory due solely to excess moisture, as necessary to obtain specified compaction. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent of the modified Proctor maximum dry density ASTM D 1557 with the top six inches of the design subgrade being compacted to 100%.

3.4.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 2 feet above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.4.1.1 Replacement of Unyielding and Unsatisfactory Materials

Unyielding or unsatisfactory materials removed from the bottom of the trench shall be replaced with satisfactory material or initial backfill material, as directed, and placed as specified for backfill.

3.4.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material or approved bridging material placed in layers not exceeding 6 inches loose thickness and compacted as directed. Care shall be taken not to over compact and pump up moisture, or otherwise weaken the underlying material.

3.4.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown or specified. Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.4.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways: Backfill shall be deposited in layers of a maximum of a 8-inch loose thickness and compacted to 95 percent maximum density, up to the elevation at which the requirements in Section 02225 EARTHWORK FOR ROADWAYS.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 8-inch loose thickness, and compacted to 95 percent maximum density. This requirement shall also apply to all other areas not specifically designated above.

3.4.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.5 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.5.1 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.5.2 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 12 inches below finished grade unless otherwise shown.

3.6 TESTING

3.6.1 Soils Tests

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation, and Atterberg limits shall be made in accordance with the procedures referenced in ASTM D 1557, ASTM D 422, and ASTM D 4318. Field tests for density and moisture content shall be made in accordance with ASTM D 1556 and ASTM D 2216 except that method ASTM D 2922 may be used to supplement tests by method ASTM D 1556. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. When soil conditions exist, which produce inconsistent results by the nuclear gauge method D 2922, only method D 1556 shall be used. Where results by Method D 2922 differ from those by Method D 1556, the results by method D 1556 shall govern for contract compliance.

The following test are required:

a. A minimum of one moisture-density test shall be performed for each classification of fill material, backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. Field density tests shall be performed as follows: a minimum of one test per lift per 100 linear feet of trench or fraction thereof is required for fill material. Locations of all tests shall be at the direction of the Contracting Officer.

G. Approval of test results shall be in accordance with the City of Chesapeake PFM. The Contractor shall bear the cost of all tests that fail to meet governing standards and specifications. In addition, the Contractor shall provide corrective meassures as required at no additional cost to the owner.

3.6.2 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

-- End of Section --

SECTION 02225

SUBGRADE AND SHOULDERS
10/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2487	(2000) Classification of Soils for Engineering Purposes
ASTM D 3786	Ref Title
ASTM D 4355	Ref Title
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	(1986; R 1994) Tensile Properties of Geotextiles by the Wide-Width Strip Method
ASTM D 4632	Ref Title
ASTM D 4751	(1999a) Determining Apparent Opening Size of a Geotextile
ASTM D 4833	(2000) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4884	(1996) Strength of Sewn or Termally Bonded Seams of Geotextiles

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 191	(1993) Density of Soil In-Place by the Sand-Cone Method
AASHTO T 205	Density of Soil In-Place by the Rubber-Balloon Method
AASHTO T 238	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods
AASHTO T 239	Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1	(1996) Safety and Health Requirements

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(January 1994) Road and Bridge Specifications
VTM-1	Laboratory Determination of Theoretical Maximum Density and Optimum Moisture Content of Soils, Granular Subbase and Base Materials
VTM-7	Atterberg Limits
VTM-8	Conducting California Bearing Ratio Tests
VTM-25	Dry Preparation and Mechanical Analysis of Soils, Select Materials, Subbases and Aggregate Bases

1.2 DEFINITIONS

Materials may consist of material in place, treated material in place, or imported material.

Materials other than regular excavation or borrow material that are shown on the plans or specified in the Contract shall conform to the applicable requirements of these specifications.

Geotextile materials used for subgrade stabilization shall conform to the requirements of PART 2 PRODUCTS.

1.2.1 Satisfactory Materials

Materials classified by ASTM D 2487 as GW, GP, SW, SP, and SP-SM are satisfactory for structural fill.

1.2.2 Unsatisfactory Materials

Materials classified by ASTM D 2487 as OL, OH and PT are unsatisfactory in-situ. Unsatisfactory materials also include those materials not listed as satisfactory, materials containing roots and other organic matter, trash, debris, frozen materials, stones larger than 3 inches in any dimension, and material which cannot support equipment or be properly compacted due to excess moisture.

1.2.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP.

Cohesive materials include materials classified as GC, SC, ML, CL, MH, and

CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are non-plastic.

1.2.4 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum density obtained by the appropriate test procedure presented in VTM-1, abbreviated hereinafter as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a 'GA" designation; submittals having an 'FIO designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS PROCEDURES:

SD-09 Reports

Soil Compaction Tests; GA.
Tolerance Tests for Subgrade; GA.

The testing laboratory shall submit three copies of all laboratory and field test reports directly to the Contracting Officer within 48 hours of the completion of the test. Required soils tests for fill, backfill, and subgrade materials shall be submitted prior to beginning fill and backfill operations.

SD-13 Certificates

Geotextile; GA.

Geotextile fabric shall be tested by an independent commercial laboratory to verify the material requirements specified in PART 2 PRODUCTS. The contractor shall provide written documentation of all tests specified. Documentation shall include style, lot, roll numbers and actual results of each test. In addition, the name, phone number of the testing laboratory and date of testing shall be provided.

1.4 DESCRIPTION

This work shall consist of constructing the subgrade in reasonably close conformity to the cross section shown on the plans and constructing the shoulders in reasonably close conformity with the plans and these specifications.

1.5 SUBSURFACE DATA

Subsurface soil boring logs are attached to Section 01055 SOIL BORING DATA. The subsoil investigation report may be examined at the Norfolk District. These data represent the best subsurface information available. Groundwater is normally encountered at 3.0 NGVD.

PART 2 PRODUCTS

Materials for Select Material, Type I shall conform to the requirements of Virginia Department of Transportation Road and Bridge Specifications (VDOT RBS), Section 207. Select Material, Type I shall conform to the requirements of Virginia Department of Transportation test procedures presented in VTM-7, VTM-8, AND VTM-25. Select Material, Type I, hereinafter also referred to as select borrow, shall be CBR-20 minimum.

Materials for Aggregate Material No. 18 shall conform to the requirements of Virginia Department of Transportation Road and Bridge Specifications (VDOT RBS), Section 209.02.

Geotextile fabric for subgrade stabilization shall be protected from mud, dirt, dust, sunlight and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to rot, mildew, insects and rodents; and biologically and thermally stable. Geotextile fabric for subgrade stabilization shall not be exposed to direct sunlight for more than 24 hours during installation.

Geotextile fabric materials for subgrade stabilization shall be woven from at least 85 percent by weight polyolefins, polyesters, or polyamides, and shall conform to the following physical properties (Minimum Average Roll Values where applies):

TABLE 2
MINIMUM PHYSICAL REQUIREMENTS FOR STABILIZATION GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB TENSILE	LBS	315	ASTM D 4632
@ELONGATION	PERCENT	15	ASTM D 4632
PUNCTURE	LBS	120	ASTM D 4833
MULLEN BURST	PSI	600	ASTM D 3786
TRAP TEAR	LBS	115	ASTM D 4533
WIDE WIDTH TENSILE	LB/IN	175	ASTM D 4595
@ ELONGATION	PERCENT	15	ASTM D 4595
APPARENT OPENING SIZE (AOS)	US SIEVE	NO.40	ASTM D 4751
ULTRAVIOLET DEGRADATION	PERCENT	70 AT 500 HRS	ASTM D 4355

PART 3 EXECUTION

The work conducted under this section shall be coordinated and accomplished in accordance with requirements specified in SECTION 02072 EXCAVATION OF PETROLEUM CONTAMINATED SOIL, SECTION 01351 SAFETY, HEALTH, AND EMERGENCY

RESPONSE (HTRW/UST), EM 385-1-1, and the Contract Drawings.

3.1 SHAPING AND COMPACTING SUBGRADE

Ditches and drains along subgrades shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until the subbase, base or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course or pavement shall be laid until the subgrade has been checked and approved. In no case shall subbase, base, surfacing or pavement be placed on a muddy, spongy or frozen subgrade.

Field density determinations shall be performed in accordance with the requirements of AASHTO T 191, AASHTO T 205, or AASHTO T 214; modified to include material sizes used in the laboratory determination of density; with a portable nuclear field density testing device; or by other approved methods. When a nuclear device is used, density determinations for embankment material shall be in accordance with 3.6, SOILS TESTS, herein.

Percentages of material will be reported to the nearest whole number.

The area to receive the material shall be graded to a true crown and cross section.

Material shall be placed and compacted in accordance with the requirements Section 02221. The subgrade area shall be scarified to a depth of 6 inches for a distance of 2 feet beyond the proposed edges of the pavement and curbs on each side. If sandy or other soil is encountered that will not compact readily, clay or other suitable material shall be added or water applied in such quantity and within the allowable moisture content specified herein as will permit compaction of the subgrade. The density of the subgrade shall be at least 95 percent of the laboratory maximum density as specified in the procedures of VTM-1.

The subgrade shall then be shaped and checked to ensure a typical cross section and uniform grade prior to placement of any subsequent courses. If the subgrade becomes eroded or distorted prior to placement of material for subsequent courses, it shall be scarified, reshaped, and re-compacted in accordance with the original requirements.

At the time of placing material for subsequent courses, the subgrade shall be compacted to the required density, free from mud and frost, and in a condition that will permit compaction of subsequent courses without distortion.

If the approved subgrade becomes unstable after placement of the subbase or base course and becomes mixed with the aggregate therein, material from the unstable area and contaminated aggregate shall be removed. The area shall then be backfilled and compacted, and the subsequent course thereon reconstructed.

3.2 TREATMENT OF UNSUITABLE SUBGRADE

When the material is not suitable for subgrade or finishing purposes, the roadbed shall be excavated and backfilled at the direction of the Contracting Officer.

3.3 FINISHING SUBGRADE

The Contractor shall provide effective drainage for the subgrade and maintain it in a satisfactory condition until the next course is placed.

Material for subsequent courses shall not be placed until the subgrade has been checked and approved. The finished subgrade elevation shall be within ±0.04 foot of the plan elevation unless otherwise specified.

3.4 GEOTEXTILE

Geotextile for subgrade stabilization shall be placed as shown on the plans. Geotextile shall be spliced by an overlap of at least 2 feet or by sewing double stitched seams with stitching spaced '1/8" to 1/4" apart or as shown on the plans. The strength of sewn seams shall be no less than 85 percent to that of the geotextile when tested in accordance with ASTM D 4884.

Once geotextile for subgrade stabilization is placed, the roadway embankment fill and subbase course materials shall be placed in accordance with applicable specification requirements in Section 02221 Earthwork and in Section 02210 Subbase, respectively. If the geotextile becomes punctured or torn, the Contractor shall repair the area with geotextile lapped at least 3 feet all around the damaged area.

3.5 SHOULDERS

Aggregate shoulder material shall be placed in accordance with the requirements of the applicable specifications governing the type of material or construction being used and shall be compacted at least 90 percent of the laboratory maximum density as specified in the procedures of VTM-1.

Percentages of material will be reported to the nearest whole number.

Aggregate material No. 18 shall be used, the density, when compared to the theoretical maximum density, shall be not less than 90 or more than 95 percent.

Shoulders shall be constructed simultaneously with non-rigid types of base or surface courses other than asphalt concrete or in advance of the base or surface course so as to prevent spreading of base or surface materials. The area of shoulders 12 inches adjacent to the pavement shall be rolled simultaneously with the course being deposited.

Where base or surface courses are being constructed under traffic and are more than 1 inch in depth, shoulder material adjacent thereto shall be placed within 72 hours after placement of the base or surface course.

3.6 SOILS TESTS

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation and Atterberg limits shall be made in accordance with the procedures referenced in VTM-1, VTM-25, and VTM-7. Field tests for density and moisture content shall be made in accordance with AASHTO T 191, AASHTO T 205, or AASHTO T 214 except that method AASHTO T 238 may be used to supplement tests by method AASHTO T 191. When AASHTO T 238 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in AASHTO T 191. AASHTO T 238 results in a wet unit weight of soil and when using this method, AASHTO T 239 shall be used to determine the moisture content of the soil. When soil conditions exist which produce inconsistent results by the nuclear gauge method AASHTO T 238, only method AASHTO T 191 shall be used. Where results by method AASHTO T 238 differ from those by method AASHTO T 191, the results by method AASHTO T 191 shall govern for contract compliance.

The following tests are required:

a. A minimum of one moisture-density test shall be performed for each classification of fill material backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six-nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

f. Field density tests shall be performed as follows: A minimum of one test per lift per 100 feet of sidewalk or fraction thereof is required for fill material. A minimum of one test per lift per 350 square yards or fraction thereof is required for fill material. A minimum of one test per 500 square yards or fraction thereof is required for compacted ground surfaces prior to filling. Locations of all tests shall be at the direction of the Contracting Officer.

3.7 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work shall be repaired and grades re-establishes to the required elevations and slopes.

-- End of Section --

SECTION 02230

CLEARING AND GRUBBING
10/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT RBS	(January 1994) Road and Bridge Specifications

1.2 DEFINITIONS

This work shall consist of clearing, grubbing, removing, and disposing of vegetation, debris, and other objects within the construction limits except for vegetation and objects that are designated to be preserved, protected, or removed in accordance with the requirements of other provisions of these specifications.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals with a "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-18 Records

Materials Other Than Salable Timber; FIO.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 PROCEDURES

If approved by the Engineer, the Contractor may clear and grub to accommodate construction equipment within the right of way up to 5 feet beyond the construction limits at his own expense. The Contractor shall install erosion and siltation control devices prior to beginning grubbing operations.

The surface area of earth material exposed by grubbing, stripping topsoil, or excavation shall be limited to that necessary to perform the next operation within a given area. Grubbing of root mat and stumps shall be confined to the area which excavation shall be performed within 15-days following grubbing.

Stumps, roots, other perishable material, and nonperishable objects that will be less than 5 feet below the top of earthwork within the area directly beneath the pavement and shoulders shall be removed. However, such material and objects that will be more than 5 feet below the top of earthwork within the area directly beneath the pavement and shoulders and all such material and objects beneath slopes of embankments shall be left in place unless removal is necessary for installation of a structure. The top of stumps left in place shall be not more than 6 inches above the existing ground surface or low water level.

Branches of trees that overhang the roadway or reduce sight distance and that are less than 20 feet above the elevation of the finished grade shall be trimmed using approved tree surgery practices in accordance with the requirements of VDOT RBS Section 601.

Vegetation, structures, or other items outside the construction limits shall not be damaged. Trees and shrubs in ungraded areas shall not be cut without the approval of the Engineer.

Trees, limbs, and other timber having a diameter of 3 inches and greater shall be disposed of as saw logs, pulpwood, firewood, or other usable material; however, treated timber shall not be disposed of as firewood.

When specified that trees or other timber is to be reserved for the property owner, such material shall be cut in the lengths specified and piled where designated, either within the limits of the right of way or not more than 100 feet from the right-of-way line. When not reserved for the property owner, such material shall become the property of the Contractor.

3.2 DISPOSAL OF MATERIALS

3.2.1 Salable Timber

All felled timber from which saw logs, pulpwood, posts, poles, ties, mine props, or cordwood can be produced shall be considered as salable timber, and shall be trimmed of limbs and tops, sawed into salable lengths. The disposal of the stockpiled timber will be by the Government Contractor.

3.2.2 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the Project Site.

-- End of Section --

SECTION 02241

AGGREGATE BASE COURSE
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 191	Density of Soil In-Place by Sand-Cone Method
AASHTO T 205	Density of Soil In-Place by the Rubber-Balloon Method
AASHTO T 238	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods
AASHTO T 239	Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods

U.S. ARMY CORPS OF ENGINEERS

EM 385-1-1	(1996) Safety and Health Requirements

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(January 1994) Road and Bridge Specifications
VTM-1	Laboratory Determination of Theoretical Maximum Density and Optimum Moisture Content of Soils, Granular Subbase and Base Materials
VTM-7	Atterberg Limits
VTM-25	Dry Preparation and Mechanical Analysis of Soils, Select Materials, Subbases and Aggregate Bases

1.2 DEFINITIONS

Aggregate base as used herein is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Plant, Equipment, Machines, and Tools; GA.

List of proposed equipment to be used in performance of construction work including descriptive data.

SD-09 Reports

Sampling and Testing; FIO.
Job Mix Formula; GA.
Field Density; GA.

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

Job mix formula shall conform to the requirements of VDOT RBS Section 208.04

SD-18 Records

Waybills and Delivery Tickets; FIO. Coarse Aggregate; FIO.

Copies of waybills and delivery tickets during the progress of the work. Certified waybills and delivery tickets for all materials actually used. A notification stating which type of coarse aggregate is to be used.

1.4 WEATHER LIMITATIONS

Base shall not be constructed when the atmospheric temperature is less than 35 degrees F. Base shall not be constructed on subgrades that are frozen or contain frost. If the temperature falls below 35 degrees F, completed areas shall be protected against any detrimental effects of freezing.

1.5 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.5.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in satisfactory working condition at all times. Other compacting equipment may be used in lieu of that specified, where it can be demonstrated that the results are equivalent. The equipment shall be adequate and have the capability of producing the results specified.

1.5.2 Steel-Wheeled Rollers

Steel-wheeled rollers shall be the self-propelled type weighing not less than 10 tons, with a minimum weight of 300 pounds per inch width of rear wheel. Wheels of the rollers shall be equipped with adjustable scrapers. The use of vibratory rollers is optional.

1.5.3 Pneumatic-Tired Rollers

Pneumatic-tired rollers shall have four or more tires, each loaded to a minimum of 30,000 pounds and inflated to a minimum pressure of 150 psi. The loading shall be equally distributed to all wheels, and the tires shall be uniformly inflated. Towing equipment shall also be pneumatic-tired.

1.5.4 Mechanical Spreader

Mechanical spreader shall be self-propelled or attached to a propelling unit capable of moving the spreader and material truck. The device shall be steerable and shall have variable speeds forward and reverse. The spreader and propelling unit shall be carried on tracks, rubber tires, or drum-type steel rollers that will not disturb the underlying material. The spreader shall contain a hopper, an adjustable screed, and outboard bumper rolls and be designed to have a uniform, steady flow of material from the hopper. The spreader shall be capable of laying material without segregation across the full width of the lane to a uniform thickness and to a uniform loose density so that when compacted, the layer or layers shall conform to thickness and grade requirements indicated. The Contracting Officer may require a demonstration of the spreader prior to approving use in performance of the work.

1.5.5 Sprinkling Equipment

Sprinkling equipment shall consist of tank trucks, pressure distributors, or other approved equipment designed to apply controlled quantities of water uniformly over variable widths of surface.

1.5.6 Tampers

Tampers shall be of an approved mechanical type, operated by either pneumatic pressure or internal combustion, and shall have sufficient weight and striking power to produce the compaction required.

1.5.7 Straightedge

The Contractor shall furnish and maintain at the site, in good condition, one 10-foot straightedge for each bituminous paver, for use in the testing of the finished surface. Straightedge shall be made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

1.6 STOCKPILING MATERIALS

Materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at locations designated. Before stockpiling of material, storage sites shall be cleared, and sloped to drain. Materials obtained from different sources shall be stockpiled separately.

1.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing shall be permitted until the facilities have been inspected and approved. Tests shall be performed in sufficient numbers and at the locations and times directed to insure that materials and compaction meet specified requirements. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

1.7.1 Test Results

Results shall verify that materials comply with the applicable sections of VDOT RBS Division 2. When a material source is changed, the new material will be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be re-tested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or modified as directed by the Contracting Officer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

Aggregate material shall conform to the requirements of VDOT RBS Section 208 Type I.

Aggregates shall be durable and sound, free from lumps of clay, organic matter, objectionable coatings, and other foreign material.

2.1.2 Calcium Chloride and Sodium Chloride

Calcium chloride and sodium chloride shall conform to the requirements of VDOT RBS Section 239.

PART 3 EXECUTION

The work conducted under this section shall be coordinated and accomplished, at a minimum, in accordance with requirements specified in SECTION 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE (HTRW/UST), EM 385-1-1, and the Contract Drawings.

3.1 GENERAL REQUIREMENTS

This work shall consist of furnishing and placing one or more courses of aggregates and additives, if required, on a prepared surface in accordance with the requirements of these specifications and in reasonably close conformity with the lines, grades, and typical sections and cross sections shown on the plans or as established by the Contracting Officer.

When the base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 PREPARATION OF UNDERLYING COURSE

3.2.1 General Requirements

The surface or course upon which the base course is to be placed shall be prepared in accordance with the requirements of the applicable provisions of Sections 02221 and 02210.

Base course material shall be mixed in an approved central mixing plant of the pugmill type. The mixed material shall be placed by means of an approved aggregate spreader.

Finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until base course is placed.

3.2.2 Density Requirements

The material shall be spread and compacted in two or more layers of approximately equal thickness. The compacted thickness of any one layer shall not exceed 6 inches.

After mixing and shaping, each layer shall be compacted at optimum moisture. The density of each layer of base aggregate material shall be 100% of when compared to the laboratory maximum density. The density shall be determined as specified in the procedures of VTM-1. Percentages will be reported to the nearest whole number.

Not more than one sample in every five shall have a density less than that specified, and the density of such sample shall be not more than 2 percent below that specified. Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 10-foot straightedge. Measurements shall also be taken perpendicular to the road centerline at 15-foot intervals. The surface of each layer shall be maintained during the compaction operations in a manner such that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied over the base materials during compaction in the amount necessary to obtain proper density.

Irregularities in the surface shall be corrected by scarifying, re-mixing, reshaping, and recompacting until a smooth surface is secured. The surface shall thereafter be protected against the loss of fine materials by the addition of moisture, when necessary, and shall be maintained in a satisfactory and smooth condition until accepted by the Contracting Officer. The aggregate base course shall be maintained in a satisfactory condition until accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact.

The base course will be tested in place for depth and density prepared in accordance with the requirements of the applicable provisions of Sections 02221 and 02225.

Acceptance of the aggregate base course for depth will be based on the requirements of Section 02225.

The Contractor shall perform compaction density testing within the pavement section and to two (2) feet behind the curb and gutter on the final crushed stone aggregate sub-base/base elevation.

3.3 SOILS TESTS

Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. Laboratory tests for moisture-density relations complete with zero air voids curve, gradation and Atterberg limits shall be made in accordance with the procedures referenced in VTM-1, VTM-25, and VTM-7. Field tests for density and moisture content shall be made in accordance with AASHTO T 191, AASHTO T 205, or AASHTO T 214 except that method AASHTO T 238 may be used to supplement tests by method AASHTO T 191. When AASHTO T 238 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in AASHTO T 191. AASHTO T 238 results in a wet unit weight of soil and when using this method, AASHTO T 239 shall be used to determine the moisture content of the soil. When soil conditions exist which produce inconsistent results by the nuclear gauge method AASHTO T 238, only method AASHTO T 191 shall be used. Where results by method AASHTO T 238 differ from those by method AASHTO T 191, the results by method AASHTO T 191 shall govern for contract compliance.

The following tests are required.

a. A minimum of one moisture-density test shall be performed for each classification of fill material backfill material, and existing subgrade material.

b. One Atterberg limits test and one gradation analysis is required for every six field density tests.

c. A minimum of one sand cone density test is required for every six-nuclear gauge field density tests or fraction thereof. Worksheets of sand density and sand cone calibration shall be submitted to the Contracting Officer prior to commencing work and each time a new supply of sand is used.

d. A quart jar sample of each moisture-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

e. A pint jar sample of each field-density test material shall be delivered to the Contracting Officer at the time the test is obtained.

Field density tests shall be performed as follows: A minimum of one test per lift per 100 feet of sidewalk or fraction thereof is required for fill material. A minimum of one test per lift per 350 square yards or fraction thereof is required for fill material. A minimum of one test per 500 square yards or fraction thereof is required for compacted ground surfaces prior to filling. Locations of all tests shall be at the direction of the Contracting Officer.

3.4 PREPARATION AND QUALITY CONTROL

The surface of the top layer shall be finished to grade and cross section shown. Finished surface shall be of uniform texture. Light blading during compaction may be necessary for the finished surface to conform to the lines, grades, and cross sections. Should the surface for any reason become rough, corrugated, uneven in texture, or traffic marked prior to completion, such unsatisfactory portion shall be scarified, reworked, recompacted, or replaced as directed.

3.4.1 Smoothness

Surface of each layer shall show no deviations in excess of 3/8 inch when tested with 10-foot straightedge. Deviations exceeding this amount shall be corrected by removing material and replacing with new material or by reworking existing material and compacting, as required.

Measurements for deviation from grade and cross section shown shall be taken in successive portions parallel to the road centerline with a 10-foot straightedge. Measurements shall also be taken perpendicular to the road centerline at 15-foot intervals.

3.4.2 Thickness

Compacted thickness of the base course shall be within ½ inch of the thickness indicated. Where the measured thickness is more than ½ inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than ½ inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within ¼ inch of the thickness indicated.

Thickness of the base course shall be measured in intervals in such a manner as to ensure one measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

3.5 DISPOSAL OF UNSATISFACTORY MATERIALS

Removed in-place materials that are unsuitable for the base course material that is removed for the required correction of defective areas, and waste material and debris shall be disposed of as specified in Section 02221.

-- End of Section --

SECTION 02362
PRESTRESSED CONCRETE PILING

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 214	(1977; R 1989) Evaluation of Strength Test Results of Concrete
ACI 304R	(1989) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 318/318R	(1989; Rev 1992; Errata) Building Code Requirements for Reinforced Concrete
ACI SP-66	(1988) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1990a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 416	(1993) Steel Stand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 421	(1991) Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A 615	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1993) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 70	(1979; R 1992) Surface Moisture in Fine Aggregate
ASTM C 136	(1993) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete

ASTM C 150	(1994) Portland Cement
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 260	(1986) Air-Entraining Admixtures for Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 566	(1989) Total Moisture Content of Aggregate by Drying
ASTM C 666	(1992) Resistance of Concrete to Rapid Freezing and Thawing
ASTM D 1143	(1981; R 1987) Piles under Static Axial Compressive Load

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1992) Structural Welding Code - Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI Jr 119	(1992) Recommended Practice for Grouting of Post-Tensioned Prestressed Concrete
PCI Mnl-116	(1985) Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI Mnl-120	(1992) PCI Design Handbook - Precast and Prestressed Concrete
PCI Std-112	(1984) Standard Prestressed Concrete Piles Square, Octagonal and Cylinder

1.2 BASIS FOR BIDS AND PAYMENT

1.2.1 Basis for Bidding

The contract includes: (16) 95-ton, and (30) 30-ton 18-inch square piles having a total aggregate length of 3110 linear feet; dynamic analysis of (6) 18-inch test piles; any necessary dynamic monitoring of initial production piles; mobilization and demobilization for load testing; and (1) 190-ton load test. The linear footage of piles is based upon piles driven to estimated tip elevations of -61.0 feet and -49.0 feet for 95-ton and 30-ton piles respectively, with the top of pile at the elevation determined by the dimensions and elevations of structural components as shown on the structural plans, and assumes an additional length of 5 feet per test pile.

1.2.2 Basis for Payment

The Contracting Officer shall have the right to increase or decrease the total aggregate length of piles to be furnished and installed by changing the pile locations or elevations, requiring the installation of additional piles, or directing the omission of piles from the requirements shown and specified. Payment for actual lengths of production piles driven in place from the indicated top of pile elevation to the final tip elevation as installed and approved, will be made at the contract unit price as bid. No payment will be made for pile length above the indicated pile cutoff elevation, except that payment for that remaining approved length of pile not driven to the required tip elevation at the direction of the Contracting Officer, will be made at the rate of 75 percent of the basic contract unit price bid. The approved length of pile is defined as the length of pile from the indicated top of pile elevation, to the required tip elevation as provided in the Contractor's approved production pile schedule. Payment for the specified length of test piles driven in place will be made at the contract unit price. Piles required to be pulled at no fault of the Contractor will be paid for at the basic contract unit price for furnishing and driving pile in its original position, plus 50 percent of this amount to cover the cost of pulling. Such pulled piles, if redriven, will be paid for at 50 percent of the basic contract unit price for the length driven. Payment for each required and approved pile cut-off or pile build-up will be paid for at the applicable contract unit price bid.

Full Compensation

Payment in accordance with the above paragraph "Basis for Payment" shall constitute full compensation for furnishing all labor, material, and equipment incidental to providing the piles in their final installed condition as specified and indicated, including mobilization and demobilization. The Contractor will not be allowed separate or additional payment for withdrawn, broken, or rejected piles; or for cut-offs or build-ups, except as required by conditions beyond the Contractor's control or responsibility and when approved by the Contracting Officer in writing.

Substitute Pile

In the event the Contracting Officer directs the Contractor to install foundation piles of a size different from that specified, the difference in the supplier's market price as of the date of bid opening, between that originally specified and that specified in the change order, shall be multiplied by the total number of linear feet of the substitute pile actually installed and accepted. Payment to the Contractor, in accordance with the preceding paragraph, shall be adjusted upward or downward, as the case may be, by the foregoing amount.

Pile Load Tests

The contract includes one (1) pile load test. The Contracting Officer reserves the right to increase or decrease the number of load tests. Payment for each complete test loading of a single pile will be made at the contract unit price per test, which price shall include furnishing, placing, and removing test apparatus and equipment, placing and removing test loads, and furnishing the load test report.

Dynamic Analysis

The contract includes dynamic analysis of six (6) test piles, in three (3) separate operations of two (2) piles each as described on the drawings. The Contractor may combine any (2) operations, or all (3) operations into a single test pile installaton event, subject to Contracting Officer approval. The Contracting Officer reserves the right to increase or decrease the number of test pile analyses. Payment for each test pile analysis will be made at the contract unit price per analysis, which price shall include furnishing, placing, and removing test sensors and equipment, monitoring test pile installation, performing Wave Equation, Refined WEAP and CAPWAP analyses, and furnishing the Dynamic Test Pile Report. Payment will not be made for additional Phase One testing necessitated by changes to the pile driving equipment or to any other aspect of the pile driving operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Pile Locations; GA.

The contractor shall furnish drawings, and data in the format of Table A provided at the back of this Section, prepared by a registered licensed land surveyor indicating final location of driven piles.

Pile Driving; GA.

A complete plan describing the proposed pile installation shall be submitted to the Contracting Officer and approved prior to driving any piles. The plan shall include details of all proposed equipment and accessories, proposed methods of operation, and the proposed sequence of driving test and permanent production piles.

Pile Driving Equipment; GA.

Contractor shall furnish to the Contracting Officer descriptions of all pile driving equipment to be employed in the work, prior to commencement of pile installations, including details of the pile hammer, power plant, leads, pile cushion material, helmet or cap, and hammer cushion material. Bounce chamber pressure rating curves or charts shall be submitted for double-acting (closed end) diesel hammers.

Dynamic Testing Equipment; GA.

The Contractor shall submit information on the dynamic load testing equipment proposed to be used and the proposed methods of operation. This submittal shall as a minimum:

1. Provide details of the proposed pile driving hammer and Wave Equation Drivability Analyses for selection of the hammer along with a statement of driving procedure. The Wave Equation Drivability Analyses are to be completed by the Contractor's Consultant for pile testing for each test pile location where different subsurface conditions exist, and are to also consider the proposed hammer assembly, pile cap block and cushion characteristics, and pile properties and estimated lengths. Analyses are to include copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analyses shall be run at the estimated tip elevation as well as other critical elevations selected by the Contractor's Consultant for pile testing, to define maximum stress levels in the pile from initial through final driving including re-srike.

2. Provide details of the proposed dynamic load testing equipment. The equipment to be used for dynamic testing of the pile hammer and soil performance and for dynamic load testing of the test piles shall be either a model GCPC or a PAK Pile Driving Analyzer as manufactured by Pile Dynamics, Inc., of Cleveland, Ohio, or approved equivalent.

3. Provide detailed procedure for conducting the dynamic pile load test, and a description of the information which will be generated by the equipment to be used for conducting the load test. The detailed description shall explain how specific information on pile performance will be evaluated to perform refined Wave Equation Analyses and to arrive at recommended installation procedures and estimated pile capacity versus penetration.

Load Testing Equipment; GA.

Provide details of the static load testing equipment and procedures, including the size, type, and length of reaction piles, description and sketch of the jacking apparatus and set-up, and description of jacking safety equipment and procedures.

SD-04 Drawings

Prestressed Concrete Piling; GA.

Contractor shall furnish to the Contracting Officer drawings including shop and erection details and details of collars, shoes, splices, build-ups, and embedded or attached lifting devices, prior to commencing the work or ordering materials. Drawings shall indicate pick-up and support points for piles. Reinforcing steel details shall conform to ACI SP-66.

SD-09 Reports

Load Test Report; GA.

Contractor shall furnish to the Contracting Officer a complete report on the load test, including a plot of applied load versus displacement and all applicable information as specified in ASTM D 1143, within 7 days of completion of load test. The report shall be prepared by or under the direct supervision of a registered professional engineer experienced in pile load testing and load test analysis. Within 7 days of receipt, or within 10 days of receipt of the Dynamic Test Pile Report, whichever occurs later, the Contracting Officer will determine the required tip elevation and driving resistance required for permanent production piles. From these requirements and from indicated finish grade of structures, the Contractor shall prepare a production schedule of the number of permanent piles of each length, required tip elevation, driving resistance, and their locations. This schedule shall be approved before any permanent production piles are ordered.

Dynamic Test Pile Report; GA.

The Contractor shall furnish, in accordance with paragraph FIELD TESTS AND INSPECTIONS, a complete printed report on the dynamic load tests, including, but not limited to, a description of the pile driving equipment, driving records for test piles, complete test data, analysis of test data, and recommended allowable design loads versus tip elevation and penetration resistance based on the test results. The .X01 electronic data files shall be provided with the report. The dynamic analysis shall include assessment of hammer performance, pile stresses and integrity, and soil resistance during installation, and shall include both CAPWAP and refined Wave Equation analyses. The report shall be prepared by or under the direct supervision of the Contractor's consultant for pile testing, who shall also inspect installation of test piles and initial production piles. A minimum of 10 days from submission of the report shall be allowed for approval. The Contractor shall use the Contracting Officer's comments and the approved test report along with the approved load test report and comments, to prepare a schedule of production pile lengths, required tip elevations, estimated driving resistance, and locations. The schedule shall be submitted and approved prior to ordering permanent production piles.

Concrete Mix Proportions and Tests; FIO.

Concrete mix proportions and test results shall be submitted and approved prior to delivery of fabricated piles to the project site. Compressive strength results shall include 28-day test results as well as results from tests taken prior to transfer of prestressing force.

SD-13 Certificates

Material Test Reports and Certificates; FIO.

Copies of material test reports shall be submitted within 24 hours after completion of tests. The testing requirements for materials incorporated in referenced documents will be waived provided the manufacturer submits certificate(s) stating that previously manufactured materials have been tested by recognized laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture, and make as that tested. Copies of the test reports need not be submitted except as specifically required by the Contracting Officer.

SAMPLE CERTIFICATE

The manufacturer hereby certifies that previously manufactured materials have been tested by recognized laboratories, that the tested material is of the same type, quality, manufacture, and formulation as that furnished for this project, and that the tested material meets all the requirements of the following specifications:

SPECIFIED MATERIAL	TESTED MATERIAL
c-150-84 Portland Cement	John Doe Company

SIGNATURE AND TITLE

SD-18 Records

Record of Existing Conditions; FIO.

Contractor shall establish a plan prepared and implemented by a professional engineer registered in the Commonwealth of Virginia, to monitor possible disturbance or cracking of the existing culvert bridge structure and the structures on adjacent properties to the existing culvert bridge during pile driving operations, bridge demolition, water and sewer demolition operations. The adjacent parcels shall include, but not be limited to, Parcels 107, 109, 110, and 113 shown on the Right of Way Plan Sheets. Minimum plan shall consist of photographs of the existing structures and the establishment of points (marks) on the existing structures to monitor in three dimensions any relative movement to a permanent benchmark located a sufficient distance from the site as to be unaffected by the Contractor's operations. A video survey, displaying a visible time and date record, shall be filed with the Contracting Officer prior to commencement of any land disturbing activities including, but not limited to, excavation, demolition, or pile driving. The survey shall include all features/items/structures that could possibly be affected by the Contractor's activities. All readings are to be taken to an accuracy of 0.01 feet. Readings and observations shall be taken daily during pile installation and for a period of 3 days after pilings are completed, and the results shall be included with the Contractor's daily inspection report. The Contractor's Existing Conditions and Monitoring Plan shall be submitted a minimum of 10 days prior to pile installation for the Contracting Officer's approval. Should any movement be detected, the Contractor shall cease operations, notify the Contracting Officer, and submit a proposed modification of his operating plan. This modified plan shall be approved by the Contracting Officer before the Contractor may proceed with the pile installation operation.

Pile Driving; FIO.

A complete and accurate record of all driven piles shall be continually maintained, and a copy shall be provided to the Contracting Officer upon request or within 5 days of completion of driving. The record shall include the pile number or identification, location, size, length, elevation of tip and top of pile, the number of blows required for each foot of penetration throughout the entire length of the pile, the number of blows per inch for the last 18 inches of penetration, and the total driving time. The record shall include the type and size of the hammer, the rate of operation, hammer stroke or pressure gauge reading, the type and dimensions of driving helmet or cap, and the cap-block and pile cushion used. Any unusual occurrence during driving of the pile shall be recorded and immediately reported to the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to driving of test piles, and 10 days prior to load testing. After installation is accepted, the complete record shall be submitted with the test.

1.4 QUALIFICATIONS

The work shall be performed by a firm specializing in the specified foundation system and having experience in constructing and installing the specified foundation system under similar subsurface conditions. The Contractor shall provide a Piling Quality Control Representative (CPQCR) with full authority to direct the pile installation activities, and shall also provide an independent Consultant for pile testing. The CPQCR or the Consultant for pile testing shall provide full-time inspection of all pile handling and installation activities, and shall have at least 2 years' experience in this field. The Contractor's consultant for pile testing shall be a professional Civil Engineer licensed by the Commonwealth of Virginia, experienced in soil mechanics and foundations and having a minimum of two (2) years' experience monitoring pile installation and testing using the specified pile driving analyzer, and shall be fully independent of the Prime Contractor and its subcontractors and suppliers.

1.5 SUBSURFACE DATA

Subsurface soil data logs are shown on the drawings. The subsurface investigation reports are available for examination at the Army Corps of Engineers, Norfolk District, 803 Front Street, Norfolk, Virginia.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Admixtures

Admixtures, if used in the concrete mixtures, shall be used at no additional cost to the Government. Chemical admixtures shall conform to ASTM C 494. Air-entraining admixture shall conform to ASTM C 260. Admixtures containing chlorides shall not be used.

2.1.2 Aggregates

Aggregates shall conform to ASTM C 33, except as specified otherwise herein. Aggregates shall be free from any substance which may be deleteriously reactive with the alkalies in the cement in an amount sufficient to cause excessive expansion of the concrete. Maximum aggregate size shall be one inch. Fine aggregates from different sources of supply shall not be mixed or stored in the same stock pile, or used alternately in the same concrete mix or the same structure without approval. The fineness MODULUS of fine aggregate shall be not less than 2.40 or greater than 3.0. For piles that will be exposed to freezing and thawing, fine and coarse aggregate subjected to five cycles of the sodium sulfate soundness test shall show a loss not greater than 10 percent. If the selected aggregates fail the soundness test, the Contractor may use the aggregate source, provided concrete specimens made with the aggregates to be used for the piles shall have a durability factor of not less than 80 based on 300 cycles of freezing and thawing when tested in accordance with ASTM C 666.

2.1.3 Anchorage

Anchorage and end fittings for post-tension assemblies shall conform to ACI 318/318R.

2.1.4 Cement

Cement shall conform to ASTM C 150 except Type IV shall not be used. Cement shall contain less than 8 percent tricalcium aluminate (C3A).

2.1.5 Grout

Grout materials used in prestressed piles shall conform to the requirements specified herein for concrete mixes. Grout for post-tensioned ducts and bonds shall conform to PCI Jr 119. Admixtures, when required for grout, shall have no injurious effects on steel or concrete. Calcium chloride shall not be used.

2.1.6 Prestressing Steel

Prestressing steel shall be seven-wire low relaxation stress-relieved strand conforming to ASTM A 416 or stress-relieved wire conforming to ASTM A 421, Type WA. The minimum ultimate strength shall be 270,000 pounds per square inch (psi). Prestressing steel shall be free from grease, oil, wax, paint, soil, dirt, loose rust, kinks, bends, or other defects.

2.1.7 Reinforcing Steel

Non-prestressed reinforcing steel shall conform to ASTM A 615, Grade 420. Welding of reinforcing steel shall be in accordance with AWS D1.4.

2.1.8 Ties and Spirals

Steel for ties and spirals shall conform to ASTM A 82.

2.1.9 Water

Water for mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalies, salts, organic materials, or other substances that may be deleterious to concrete or steel. Mortar cubes made with nonpotable mixing water shall have 7-day and 28-day strengths equal to at least 90 percent of the strengths of similar specimens made with potable water.

2.2 MANUFACTURED UNITS - GENERAL REQUIREMENTS

2.2.1 Pretensioned Piles

Pretensioned piles may be solid or hollow and shall be cast as monolithic units of homogeneous high-strength concrete from head to tip and stressed with high-tensile cold-drawn stress-relieved steel strands. Design criteria shall be in accordance with PCI Mnl-120 and PCI Std-112. Manufacturing of piles shall conform to PCI Mul-116 except as modified herein.

2.2.2 Seawater Exposure

For piles to be exposed to seawater, the concrete mix design and the concrete materials shall be selected, placed, and cured in a manner that ensures production of extremely dense concrete free of shrinkage cracks and honeycomb with a minimum degree of permeability. The maximum permissible water-cement ratio (by weight) shall be 4.5 gallons of water per sack of cement. The cement shall be air entrained with a minimum of 4-1/2 percent and a maximum of 6 percent air entrainment, accomplished by use of an additive at the mixer and approved by the Contracting Officer.

2.2.3 Conveying

Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods that will not cause segregation or loss of ingredients in accordance with ACI 304R. It shall be deposited as nearly as practicable in its final position in the forms. At any point in conveying, the free vertical drop of the concrete shall not exceed 3 feet. Chuting will be permitted only where the concrete is deposited into a hopper before it is placed in the forms. Conveying equipment shall be cleaned thoroughly before each run. Concrete shall be deposited as soon as practicable after the forms and the reinforcement have been inspected. Concrete that has segregated in conveying shall be removed.

2.3 FABRICATION OF PRETENSIONED PILES

Production piles shall not be fabricated and delivered to the site until the Dynamic Test Pile Report and Load Test Report and the Contractor's production pile schedule are approved.

2.3.1 Workmanship

Workmanship shall conform to PCI Mnl-116. Pile pick-up points shall be as recommended by PCI and at the responsibility of the Contractor. Unless special lifting devices are attached for pick-up, location of pick-up points cast in the concrete shall be plainly marked on all piles after removal of the forms, and all lifting shall be done at these points. Piles shall be lifted by a suitable bridge or sling attached to the pick-up points. Piling shall not be driven until the concrete attains the specified ultimate compressive strength as indicated by breaking test cylinders.

2.3.2 Forms

Forms shall be of metal, shall be well braced and stiffened against deformation, and shall be accurately constructed and watertight. Forms shall permit movement of the pile without damage during release of the prestressing force. Bottom of the form shall be within 1/4-inch of a true plane in a length of 50 feet. Inside forms or void tubes may be of treated fiberboard, plywood, or other material and/or method approved by the Contracting Officer. Void forms shall be anchored firmly so they will not move, float, or collapse during the placing of concrete. If a moving mandrel is used for forming the inner void, special precautions shall be taken to prevent fallout of inner surfaces, tensile cracks, and separation of concrete from strands.

2.3.3 Reinforcement and Embedments

All reinforcing steel, prestressing steel, and embedded items shall be accurately positioned in the forms and secured to prevent movement during concrete placement. All steel shall have a minimum concrete cover of 2 inches, except in marine or other corrosive environments where the minimum concrete cover shall be 2-1/2 inches.

2.3.4 Concrete Work

The concrete mix shall have an ultimate compressive strength of 6000 psi at 28 days and a slump of 2 to 5 inches, as determined in accordance with ASTM C 143. Water reducing admixtures, when approved by the Contracting Officer, shall produce concrete with a slump not exceeding 7 inches. Concrete piles exposed to conditions of freezing and thawing shall contain from 4 to 7 percent entrained air provided by the use of an air-entraining admixture conforming to ASTM C 260. Concrete shall not be deposited in the forms until the placement of reinforcement and anchorages has been inspected and approved. Each pile shall be produced of dense concrete with smooth surfaces. Concrete shall be placed promptly after mixing is completed and shall be deposited close to its final position in the form. Vibrator heads shall be smaller than the minimum distance between steel for pretensioning. Dimensional tolerances shall conform to PCI Mnl-116. The ends of all piles and the corners of square piles shall be chamfered. Side forms shall not be removed until concrete has attained 4200 psi compressive strength, as determined by breaking test cylinders.

2.3.5 Pretensioning

Anchorages for tensioning the prestressing steel shall be a type approved by the Contracting Officer. The tension to which the steel is to be pretensioned shall be measured by the elongation of the steel and verified by the jack pressure reading on a gauge. The gauge shall have been re-calibrated by a calibration laboratory approved by the Contracting Officer within 12 months of commencing work and every 6 months thereafter during the term of the contract. Means shall be provided for measuring the elongation of the steel to at least 1/8 inch. When the difference between the results of measurement and gauge reading is more than 5 percent, the cause of the discrepancy shall be corrected. The tensioning steel shall be given a uniform prestress prior to being brought to design prestress. The same initial prestress shall be induced in each unit when several units of prestressing steel in a pile are stretched simultaneously.

2.3.6 Detensioning

Releasing of prestressing force in pretensioned piles shall be performed in a manner that minimizes eccentricity of prestress. Tension in the strands shall be released from the anchorage gradually. In no case shall the stress be released after casting without approval by the pile manufacturer's quality control representative. The transfer of prestressing force shall be done when the concrete has reached a compressive strength of not less than 70 percent of specified ultimate, as determined by breaking test cylinders.

2.3.7 Curing of Piles

Prior to the start of curing operations, the methods and details of curing shall be submitted for record and shall be approved by the Contracting Officer. All piles shall be cured in accordance with Section 4 of PCI Mnl-116.

2.4 MANUFACTURING CONTROLS

2.4.1 Initial Sampling and Testing

Testing shall be performed by an approved commercial testing laboratory or by an approved laboratory maintained by the manufacturer of the material.

2.4.1.1 Aggregate

Fine and coarse aggregate shall be tested for conformance with ASTM C 33.

2.4.1.2 Cement

Cement shall be tested at the mill or at the mixing plant for conformance with ASTM C 150.

2.4.1.3 Mix Proportions

Prior to commencing pile fabrication, the Contractor shall furnish a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete proposed for use. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, or by an approved laboratory maintained by the pile fabricator, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory. The statement shall also be accompanied by test results demonstrating compliance of aggregate and cement, as specified herein.

2.4.2 Sampling and Testing During Fabrication

2.4.2.1 Aggregate

Twice during each shift when the concrete plant is operating, the gradation of each size of aggregate shall be tested in accordance with ASTM C 136. At least one test of moisture content of coarse aggregate, in accordance with ASTM C 566, and at least two tests of moisture content of fine aggregate, in accordance with ASTM C 70 or ASTM C 566, shall be made per shift.

2.4.2.2 Concrete

A minimum of two slump tests in accordance with ASTM C 143 shall be made for each 50 cubic yards of concrete produced per shift. Samples of fresh concrete shall be taken in accordance with ASTM C 172. Cylinders shall be molded and cured in accordance with ASTM C 31, and tested in accordance with ASTM C 39. Samples comprised of at least three (3) test cylinders for each class of concrete shall be taken not less than once a day nor less than once for each 50 cubic yards of concrete placed. Each strength test result shall be the average of two cylinders from the same sample tested at 28 days. Additional specimens shall be molded as needed by the Contractor or pile manufacturer. The Contractor or pile manufacturer shall mold, ship, cure, and test the cylinders. The cylinders shall be cured in the same manner as the piles and shall be placed at the point where the poorest curing conditions are offered. Evaluation of the compressive test results tested at 28 days shall be in accordance with ACI 214. The Contractor or pile manufacturer shall certify that the sampling and test methods conform to the requirements of ASTM C 31 and ASTM C 39 and that sufficient samples were taken to evaluate the concrete as follows: The average of three consecutive strength tests shall equal or exceed the specified strength and no individual strength test result shall have less than the specified strength by more than 500 psi. All test results shall be submitted to the Contracting Officer, for review and approval prior to delivery of piles to the project site.

2.4.3 Changes in Proportions

If the test results of the laboratory cured cylinders at 28 days fall below the specified compressive strength, adjustments in the proportions, the water content, or both shall be made as necessary; if the test results of the field-cured specimens fall below the specified strength, changes in the casting, handling, or storage method and the moisture and curing procedures of such specimens shall be made as necessary to secure the specified strength. All changes shall be submitted in writing to the Contracting Officer. The slump shall be as specified.

PART 3 EXECUTION

The Contractor shall select pile driving equipment based upon subsurface conditions, pile size and capacity, and local experience, and Wave Equation Drivability Analyses results per paragraph 1.3 SUBMITTALS. Stresses predicted by wave equation analysis shall not exceed the effective prestress in tension, and 0.85 times the concrete compressive strength minus the effective prestress. Between 7 and 21 calendar days prior to installing test piles, the Contractor's Piling Quality Control Representative (CPQCR) and the Contractor's Consultant for pile testing shall conduct a Preparatory Inspection with the Contracting Officer's Representative. The inspection shall include, but not be limited to, a review of the approved pile driving and testing equipment submittals and a discussion of the proposed installation program. Final approval of driving equipment and procedures shall be based upon driving results of test piles and approved recommendations by the Contractor's Consultant for pile testing, but approval shall not relieve the Contractor of the responsibility of achieving satisfactory installation of test and production piles as specified and indicated.

3.1 PILE DRIVING EQUIPMENT

3.1.1 Pile Hammers

The hammer used shall be capable of developing the specified ultimate pile capacity prior to reaching driving refusal, and shall be capable of proving the specified ultimate capacity during Phase Two testing re-strike, considering hammer impact velocity; ram weight; cross section, length, and total weight of the pile; and the character of subsurface material to be encountered. For air or steam hammers, obtain required driving energy of hammer by use of a heavy ram and a short stroke with low impact velocity. Initial hammer selection and operating procedure shall be in accordance with Wave Equation Drivability Analysis results per paragraph 1.3 SUBMITTALS. Hammer operation shall be modified, or the hammer replaced, during test pile or production pile installation as required, in accordance with refined Wave Equation Analyses and Pile Dynamic Analyzer results or as recommended by the Contractor's Consultant for pile testing. Single-acting hammers shall have an indicator and scale, easily legible from the ground, for hammer stroke measurement. A gauge to monitor air or steam hammer pressure, or diesel hammer bounce chamber pressure, shall be readable by inspectors on the ground.

3.1.2 Driving Helmets and Pile Cushions

A driving helmet or cap including a pile cushion shall be used between the top of the pile and the ram to prevent impact damage to the pile. The driving helmet or cap and pile cushion combination shall be capable of protecting the head of the pile, minimize energy absorption and dissipation, and transmit hammer energy uniformly over the top of the pile. The driving helmet or cap shall fit loosely around the top of the pile so that the pile is not restrained by the driving cap if the pile tends to rotate during driving. The pile cushion may be of solid wood or of laminated construction, shall completely cover the top surface of the pile, and shall be retained by the driving helmet. The minimum thickness of the pile cushion shall be 6 inches and the thickness shall be increased as recommended by the Contractor's Consultant for pile testing and approved by the Contracting Officer's Representative so as to be suitable for the size and length of pile, character of subsurface material to be encountered, hammer characteristics, and the required driving resistance. The pile cushion shall be new at start of driving of each pile, and it shall be replaced if it has been highly compressed, charred, or burned, or has become deteriorated in any manner during driving, but shall not be changed within the last 3 feet of driving..

3.1.3 Hammer Cushion

A hammer cushion, when recommended by the hammer manufacturer, shall be used between the helmet or cap and the hammer ram. The cushion shall consist of aluminum and approved industrial type plastic laminate (micarta) discs stacked alternately in a steel housing. Steel plates shall be used at the top and the bottom of the hammer cushion. Where the cushion is other than that specified above, the Contractor shall submit to the Contracting Officer, at least 2 weeks before the start of test pile driving operations, detailed drawings of the cushion he proposes to use accompanied by records of the successful use. The hammer cushion shall be replaced if it has been damaged, highly compressed, charred, or burned or has become spongy or deteriorated in any manner. If a wood cushion is used, it shall not be replaced during the final 3 feet of driving of any pile. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy be permitted.

3.2 INSTALLATION

All pile handling and installation shall be performed under the direct supervision of the CPQCR for pile installation, as specified in paragraph QUALIFICATIONS.

3.2.1 Handling and Driving

Piles or pile sections shall not be handled or moved in any manner that would result in cracking or permanent damage to the concrete or to the grout surrounding the prestressing cables. Piles shall not be driven until the concrete has attained a minimum strength of 6000 psi. Piles may be driven without pile guides or leads providing a hammer guide frame is used to keep the pile and hammer in alignment. Special care shall be taken to support battered piles to prevent excessive bending stresses in the pile. Piles with strands or steel reinforcement projecting from the head shall be driven with special driving heads fitted to the pile.

3.2.2 Pile Driving

The Contracting Officer shall be notified at least 10 days prior to beginning installation of test piles. Pile driving records shall be prepared in accordance with paragraph SUBMITTALS. Well in advance of beginning any pile installation so as to avoid delays to piling operations, probing and removal of erosion protection materials shall be performed as indicated on drawing Sheets D-1 and D-3. All pile driving shall be fully monitored and recorded by the Contractor's consultant for pile testing or by the CPQCR. During initial driving through the specified probing and pre-augered depth and while the pile tip is penetrating layers of very soft soil, steam and air hammers shall use a reduced driving energy of the hammer and the pile cushion thickness shall be increased or other measures taken as necessary to prevent tensile stresses from exceeding allowable limitsas necessary to prevent tensile stresses from exceeding allowable limits. Diesel-powered hammers shall be operated at the rate recommended by the manufacturer throughout the entire driving period. Sufficient pressure shall be maintained at the steam or air hammer so that:

a. For a double-acting hammer, the number of blows per minute during and at the completion of driving of the pile is equal approximately to that at which the hammer is rated.

b. For a single-acting hammer, there is a full upward stroke of the ram, unless a shortened stroke is directed by the Contractor's Consultant for Pile Testing..

c. For a differential type hammer, there is a slight rise of the hammer base during each upward stroke.

Test piles shall be installed and tested in accordance with paragraph FIELD TESTS AND INSPECTIONS. The pile hammer used for driving permanent piles shall be the same type, operated at the same rate and in the same manner, as that used for driving the test piles, except when refined Wave Equation Analyses or Dynamic Pile Analyses indicate revisions are required as recommended by the Contractor's Consultant for pile testing. Additional Phase One testing shall be provided as necessary for initial production piles as specified in paragraph Dynamic Pile Analyses. Permanent production piles shall be driven continuously and without interruption, to or below the required tip elevation or to reach the driving resistance in accordance with the approved production pile schedule, and such that the top of pile is at the final location indicated. Pile driving records shall be monitored daily by the Contractor's consultant for pile testing, whose recommended reivisions to the procedures and equipment shall be promptly instituted. If a pile refuses prior to reaching the required tip elevation or if obstructions or unusual conditions are encountered, the Contractor shall immediately notify the Contracting Officer and perform corrective measures as directed by him. Driving refusal shall occur if the number of properly delivered hammer blows exceed 70 blows per six inches or 120 blows per 12 inches of penetration or as recommended and approved in the Dynamic Test Pile Report. Any pile failing to meet the approved driving resistance at the required tip elevation, shall be re-struck as recommended by the Consultant for pile testing and in the presence of the Consultant for pile testing or the Contracting Officer. Dynamic formulae such as the Engineering News Record (ENR) formula shall not be used to determine the driving resistance at which pile driving will be terminated.

3.2.3 Jetting of Piles

Jetting of piles will not be permitted.

3.2.4 Cutting of Piles

When necessary and approved by the Contracting Officer in writing, cutting of piles shall be with pneumatic tools, sawing, or other approved methods which will not damage the pile below the surface of the cut. The use of explosives for cutting will not be permitted. Payment for cutting of piles required by condition beyond the control or responsibility of the Contractor will be made in accordance with paragraphs BASIS FOR BIDS AND PAYMENT.

3.2.5 Protection of Piles

Care shall be taken to avoid damage to the piles in handling piles, in placing the pile in the leads, and during the pile driving operations. Where pile or projecting reinforcement orientation is essential, special care shall be taken to maintain the orientation during driving. Special care shall be taken in supporting battered piles to prevent excessive bending stresses in the pile. The top of the pile shall be squared to the longitudinal axis of the pile. If the Contractor elects to use a pile head with projecting strands or mild steel reinforcing, a special driving head shall be used to prevent damage to the reinforcement and prevent direct impact forces from being transmitted through the reinforcement.

3.2.6 Tolerances in Driving

All piles shall be driven with a variation of not more than 0.25 inch per foot of pile length from the vertical for plumb piles or more than 0.50 inch per foot of pile length from the required angle for batter piles. Top of pile shall be within 4 inches laterally and within 2 inches vertically of the location indicated. When piles are driven such that the top of pile is lower than indicated, the connecting pile cap or grade beam shall be increased in depth such that the pile is embedded for the minimum dimension shown. Manipulation of piles, up to a maximum of 0.15 inches per foot of length but in no case more than 4 inches, will be permitted to bring pile tops to within tolerance. All piles shall be checked for heave. Piles found to have heaved shall be redriven to the required point elevation.

3.2.7 Build-Ups

If any pile does not attain sufficient resistance or penetration when the pile head is at the established cut-off elevation, driving shall continue as directed by the Contracting Officer until the required resistance or penetration is reached. The pile shall be built-up to the specified cut-off elevation by a cast-in-place extension of the pile, in accordance with procedures for build-up without driving as detailed in PCI Std-112. Details of means for protecting the joints by a suitable mortar or epoxy shall be approved by the Contracting Officer. Build-ups shall not be driven. Where build-ups are exposed to water, the Contractor shall protect the cast-in-place section from the water during the curing period, in a manner approved by the Contracting Officer. Concrete in build-up shall have a minimum ultimate compressive strength of 4000 psi. Build-ups will not be permitted on more than 10 percent of the total number of piles. If this percent figure is exceeded or if in the judgment of the Contracting Officer the clustered location of the build-ups is undesirable, piles of insufficient length shall be withdrawn and replaced with longer piles. Payment for such build-ups, withdrawal and replacement will be made in accordance with paragraph BASIS FOR BIDS AND PAYMENT, except when such work is required due to the fault of the Contractor. If pile tops are damaged during driving, the damaged portion shall be removed and the pile built-up, or the pile shall be removed and replaced, as directed by the Contracting Officer and at no additional cost to the Government.

3.2.8 Splices

Splicing of piles will not be permitted.

3.2.9 Pilot Piles

Pilot piles shall not be permitted to break or cut through obstructions.

3.2.10 Preaugering

All pile locations for the utility Aerial Crossing shall be preaugered or spudded to a depth of 5 feet below the mud line, to identify and clear possible obstructions. The area of the auger or spud shall not exceed 80 percent of the pile cross-sectional area. Alternative methods of clearing any obstacles, to ensure an unobstructed path for installing piles, may be submitted for approval by the Contracting Officer, but no additional payment will be made therefore.

3.2.11 Damaged Piles

a. When the tip of a driven pile is passing through soft soil so that there is little or no resistance to penetration of the pile, longitudinal tensile stresses may be generated in the pile shaft. These tensile stresses may be sufficient to damage the pile during driving. For such driving conditions, the contractor shall modify his driving procedures to limit the tensile stresses in the piles to acceptable levels. Piles which fail due to longitudinal tensile stresses caused by inappropriate driving shall be replaced by the Contractor at no additional expense to the Government.

b. Should any pile be damaged during driving, or be driven outside its specified tolerance for position, or otherwise be rejected due to non-conformance with the requirements of the contract, it shall be abandoned and additional pile or piles shall be installed at no additional cost, in the locations designated by Contracting Officer to replace the abandoned pile. Such changes in pile caps, strap beams, and reinforcement made necessary by such pile relocations shall be made without additional cost. Abandoned piles shall be cut off below the bottoms of the pile caps, or lower as directed by the Contracting Officer.

c. If any pile driven to the specified resistance in the specified strata is found to be out of plumb, or if its center at the level of the cut off is out of position or any pile is loaded more than 10 percent greater than its design load, or so as to change the shape of the pile group making it necessary to investigate and redesign the pile caps or other foundation concrete, the contractor shall provide additional piles as directed, or make such changes in pile caps, strap beams, or foundation walls, as directed, so that no pile in the completed group will be loaded more than 10 percent greater than its designed load, computed from an assumed fully loaded condition in its designed position. The cost of additional piles and changes to concrete pile caps, mats, strap beams, etc., made for this purpose shall be borne by the contractor.

d. Work of whatever nature, including cost of investigating and redesign, required on account of rejected, damaged, or displaced piles, excepting piles which have been abandoned at the Government's expense due to obstructions as stipulated herein, shall be provided by the contractor as directed and without additional cost.

e. For efficient prosecution of the work, the licensed land surveyor engaged by the contractor shall convey partial pile survey information to the Contracting Officer at intervals, so that any necessary investigation and redesign may proceed at a reasonable time. At the conclusion of the work, however, all pile survey information shall be furnished on a drawing as described under SUBMITTALS. The Government reserves the right to take up to 5 working days to review and approve final pile locations.

3.2.12 Obstructions to Driving Piles

a. If obstructions are encountered below the bottom of the pile cap, the contractor shall remove partially driven pile or use a mandrel or a steel spud to clear a way for the pile or piles. If so ordered by the Contracting Officer in writing, obstructions encountered beyond the limits of erosion protection material probing and removal that cannot be cleared, shall be removed by the contractor and payment therefor will be made in accordance with the Contract clauses. Because of the obstructions, under this paragraph, the Contracting Officer may abandon piles and order additional piles and the footage of such piles abandoned and additional piles shall be included at the applicable contract unit price. The additional cost of pile cap, struts, or girders required because of obstructions under this paragraph will be borne by the Government. When not caused by obstructions, these costs shall be borne by the Contractor. The investigation and redesign costs shall be paid as stipulated under DAMAGED PILES.

b. If, subsequent to the driving of a completed pile, the pile is damaged by an obstruction during the driving of another pile, the Government will pay the cost of the work ordered by the Contracting Officer to correct the condition.

c. If the pile gets out of alignment by loss of contact with the driving apparatus, or if it is abandoned during the operation and thereafter constitutes an obstruction in the ground and causes damage to a pile in the same or adjacent location, the contractor shall assume all costs attributable to the displaced part or parts.

3.3 FIELD TESTS AND INSPECTIONS

The Contractor shall notify the Contracting Officer 10 days prior to driving of test piles and 10 days prior to conducting load test, in order to witness the driving, testing, and recording procedures of the piles.

3.3.1 Test Piles

Four (4) 95-ton test piles and two (2) 30-ton test piles conforming to the requirements for permanent piles shall be driven at the locations as described on the drawings and to tip elevations of -61.0 feet and -49.0 feet respectively or as otherwise directed by the Contracting Officer.

Installation of all test piles shall be observed by the CPQCR and by the Contractor's Consultant for Pile Testing, and monitored as specified herein.

For each test pile, a record shall be kept as specified in paragraph SUBMITTALS. The piles and pile driving shall conform to the requirements specified herein and, unless directed otherwise by the Contracting Officer, driving shall be continuous until the tip of the pile has been driven to the tip elevation specified above. Any or all of the additional test pile length shall be driven after successful re-strike testing or static load testing such that the permanent top of pile is located at its design elevation, unless the Contractor's Consultant for pile testing determines that the driving stresses will be damaging to the pile, in which case the top of pile shall be cut off as required. Jetting of test piles will not be permitted. Test piles indicated or directed to be driven in permanent locations may be incorporated into the work if they are approved by the Contracting Officer after all testing has been completed. Within 7 days of receipt of the complete dynamic test pile report including the Consultant's recommendations and the full set of test pile driving records, the Contracting Officer will determine which test pile is to be load tested.

3.3.2 Dynamic Pile Analyses

A dynamic pile analysis shall be performed on each of the test piles.

3.3.2.1 Phase One

The first phase will occur when the test piles are initially driven to check the hammer, pile, and soil performance, and to determine the suitability of the proposed hammer for the size, length and type of pile being driven for the soil types encountered as the piles are driven. This initial monitoring shall determine the most appropriate pre-augering depth, efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile and extent/location of any pile damage caused by the initial driving. Test piles damaged or broken during installation shall be replaced, incorporating driving modifications as determined by the Contractor's Consultant for pile testing and as approved by the Contracting Officer. With each blow of the pile, the information listed below shall be electrically recorded and analyzed by the Pile Driving Analyzer:

a. Blow number

b. Blow rate per minute, or hammer stroke for diesel hammers

c. Input and reflected values of force and velocity

d. Value of upward and downward traveling force wave with time

e. Maximum and final transferred energy to pile, hammer system efficiency

f. Maximum compressive stress, velocity, acceleration and displacement

g. Maximum tensile stress in pile

h. Pile structural integrity, damage detection, extent and location.

i. Bearing capacity of pile by Case method.

If the pile test, hammer, and soil performance evaluation recommends changes to the hammer assembly, hammer stroke, pile cushioning, augering, or any other aspect for the pile driving operation, these changes shall be incorporated into production pile driving in an effort to control excessive stresses and pile damage. Phase One testing shall then be performed for the first four production piles to monitor the incorporated changes or any other Contractor changes in any aspects of pile driving operations made after test pile installation, and the Contractor shall not proceed with further production pile driving until the results and any further recommendations made by his Consultant for pile testing are reviewed and approved by the Contracting Officer and implemented by the Contractor. This procedure shall be repeated until allowable tensile and compressive stresses are achieved in the pile and/or pile damage is minimized.

3.3.2.2 Phase Two

Upon completion of Phase One test pile driving, the piles shall be allowed to set-up for at least 72 hours, or longer as recommended by the Contractor's Consultant for Pile Testing. After evaluation of pile, hammer and soil performance by the Contractor's consultant for pile testing, the second phase of the dynamic pile analysis shall proceed. The second step of dynamic pile analysis is the dynamic load test. This portion of the evaluation requires striking each of the set-up piles, i.e. re-striking the test piles, a minimum of 20 to 50 times or as directed by the Contractor's consultant, using the same hammer which was used for the test pile driving and which will be used for production pile driving. In addition to those items listed in paragraph Phase One above, selected re-strike driving records for each test pile, as directed by the contractor's Consultant for Pile Testing and approved by the contracting Officer, are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution and soil resistances and properties, generation of a plot of applied load versus average pile displacement based on the calculated soil properties, and establishment of driving criteria for production piles.

3.3.3 Dynamic Test Pile Report

Upon satisfactory completion of all dynamic load testing for each specified test pile operation, a minimum of three copies of a Dynamic Pile Test Report shall be submitted to the Contracting Officer for review and approval. The submittal shall be prepared and sealed by the Contractor's Consultant for Pile Testing and shall be made within ten (10) days of the completion of the dynamic load test. The report for the Dynamic Pile Analysis shall contain the following information:

a. Bearing capacity of pile(s) from Case Pile Wave Analysis Program (CAPWAP) information resulting from analysis of selected restrike blows.

b. Maximum and final transferred energy, hammer system efficiency.

c. Maximum compressive stress, velocity, acceleration and displacement.

d. Maximum tensile stress in pile.

e. Calculation of allowable stresses and comparison with measured values, and any recommended changes to driving operations.

f. Pile structural integrity, damage detection, extent and location.

g. Blows per minute or hammer stroke as applicable, and blow number.

h. Input and reflection values of force and velocity, upward and downward traveling force wave with time.

i. Pile skin friction and toe resistance distribution.

j. Maximum energy transferred to pile.

k. Recommended tip elevations, driving refusal criteria (maximum blows per inch), and driving criteria to include end of driving and re-strike penetration resistances (blows per foot) and related hammer strokes/rates, for production piles to achieve the specified design capacity.

l. Recommended pile and ASTM D1143 testing procedure for static load testing.

Upon satisfactory completion of a static load test, the Contractor's Consultant for pile testing shall propose the maximum allowable pile design load for the tested and indicated pile tip elevations, and the recommended tip elevations to achieve the specified design capacity along with any recommended revisions to the proposed driving criteria provided with the dynamic testing report.

3.3.4 Load Test

Load test shall be performed on one test pile in accordance with ASTM D 1143 and as specified herein. The apparatus for applying the vertical loads shall be as given by the method either for load supported directly by the pile, or load from weighted box or platform or reaction frame attached to sufficient reaction piles to take safely the required load applied to the pile by hydraulic jack. Additional load tests, at the expense of the Government at the bid price, may be required. The contractor shall be responsible for furnishing and setting up load apparatus and load measuring equipment. The load apparatus and measuring equipment shall be of sufficient capacity to apply a maximum load of not less than 190 tons. Loading, testing, and recording shall be under the supervision of the Contractor's Consultant for pile testing. Piles shall be load tested to the full ultimate test load of 190 tons, which is two times the design working capacity of the pile. The Quick Loading Procedure shall be used, except that the full test load shall be maintained for not less than 1 hour and then released in 25 percent decrements with 5 minutes between decrements. The load test report shall be submitted in accordance with paragraph SUBMITTALS.

TABLE A

PILE SURVEY & TABULATION

PROJECT LOCATION: ____
TITLE: ________________________________ CONTRACT NO:__________
SURVEYED BY: __________________________ DATE: ______________
REFERENCE DRAWINGS: ____
____

PILE GROUP NO.	PILE NO.	PERMISSIBLE DEVIATION			ACTUAL DEVIATION			OUT OF TOLERANCE		
		X	Y	Z	X	Y	Z	X	Y	Z

REMARKS ____
____
____

-- End of Section --

SECTION 02411

SHEET PILING AND COFFERDAMS
04/98
Great Bridge Culvert Bridge Replacement

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36	(1996) Carbon Structural Steel
ASTM A 325	(1993) High Strength Bolts for Structural Steel
ASTM A 328	(1993a) Structural Carbon Steel Sheet Piling

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Pile Locations; GA.

The Contractor shall furnish drawings and data prepared by a certified licensed land surveyor indicating final location of driven sheet piles. Drawings shall also identify any interferences with the existing culvert bridge and with any existing or new utilities, tiebacks, drainage structures, or roadways.

Pile Driving Equipment; GA.

Description of all pile driving equipment to be employed in the work, prior to commencement of pile installations, including details of the pile hammer, and power plant. Drawings shall be developed identifying the positioning of the pile driving equipment during the driving operations. Driving equipment selection shall be based upon the ability to install the sheet piling with the least potential of disturbing features which are required to remain in service, including but not limited to the existing roadway, culvert bridge, utilities, and structures in the vicinity of the driving operation.

Calculations; GA

Design calculations showing the required sizing and tip elevations/embedment of temporary sheet piling or proposed alternative methods/materials, shall evaluate the stresses on the required sheet piling during all stages of construction detailed in the Work Plan. This shall include, but not be limited to, the identification and consideration of all anticipated loads as well as the pressure distribution for all stages of backfill placement. Additional calculations shall be provided demonstrating the pile driving equipment is adequately supported during driving operations and does not produce any adverse effects on the existing or new structures.

SD-04 Drawings

Steel Sheet Piling; GA

Drawings including shop and erection details and attached lifting devices, prior to commencing the work or ordering materials.

Cofferdams; GA

Drawings shall include layout and sizes of sheeting, struts and connections, identify any interferences, sequence of operations, backfilling, and dewatering operations, and positioning of the pile driving equipment.

Work Plan; GA

A work plan showing the sequence of construction for both the temporary sheeting and permanent bulkheads, and any proposed alternative to sheeting for temporary support or shoring. This work plan shall include provisions for, at a minimum, demolition plans, driving of sheet piling, driving of concrete piles, backfilling, installation of soil anchors and tie rods, and stressing of soil anchors and tie rods.

SD-13 Certificates

Material Test Reports and Certificates; GA.

Certified copies of physical and chemical test results which shall include a sworn statement by a qualified mill representative to the effect that the subject material conforms to the requirements of the steel specified.

SD-18 Records

Records of Existing Conditions; FIO.

Contractor shall establish a plan to monitor possible disturbance or cracking of the existing culvert bridge structure and the adjacent properties to the existing culvert bridge during pile driving operations, bridge demolition, water and sewer demolition operations. The adjacent parcels shall include, but not limited to, Parcels 107, 109, 110, and 113 shown on the Right of Way Plan Sheets. Minimum plan shall consist of photographs of the existing structure and the establishment of points (marks) on the existing structure to monitor in three dimensions any relative movement to a permanent benchmark located a sufficient distance from the site as to be unaffected by the Contractor's operations. A video survey, displaying a visible time and date record, shall be filed with the Contracting Officer prior to commencement of any land disturbing activities including, but not limited to, excavation, demolition, or pile driving. The survey shall include all features/items/structures that could possibly be affected by the Contractor's activities. All readings are to be taken to an accuracy of 0.01 feet. Readings and observations shall be taken daily during sheet pile installation and for a period of one week after sheet piling is completed, and the results shall be included with the Contractor's daily inspection report. The Contractor's Existing Conditions and Monitoring Plan shall be submitted a minimum of 10 days prior to sheet pile installation for the Contracting Officer's approval. Should any movement be detected, the Contractor shall cease operations, notify the Contracting Officer, and submit a proposed modification of his operating plan. This modified plan shall be approved by the Contracting Officer before the Contractor may proceed with the sheet pile installation operation.

1.3 DESIGN

Temporary sheet piling or proposed alternative methods/materials shall be designed in accordance with the AASHTO Guide Design Specifications for Bridge Temporary Works. All designs shall be performed by a registered Professional Engineer (who is registered in the Commonwealth of Virginia), and shall include, but not be limited to, the applicable requirements in paragraph SUBMITTALS.

1.4 SHEET PILING AND COFFERDAMS

1.4.1 Permanent Sheet Piling

Under this work, the Contractor shall furnish and place permanent sheet piling of the type and at the locations shown on the plans or as ordered by the Contracting Officer. All the piling and supports will be left in place as part of the finished structure unless removal of waling and bracing is called on the plans.

1.4.2 Temporary Sheet Piling

This work shall include the requirements specified above with the following addition: The Contractor shall be required to maintain the sheet piling while in place and remove it from the job site after its function has been accomplished or when ordered by the Contracting Officer. Temporary sheet piling intended to be left partially in place, as allowed in Paragraph 3.2, TEMPORARY SHEET PILING, shall be so indicated on the shop drawings submitted for approval per Paragraph 1.2 SUBMITTALS.

1.4.3 Cofferdams

Under this work, the Contractor shall furnish, place, maintain, and remove cofferdams together with all necessary waling and bracing, and unwatering equipment.

1.4.4 Cofferdams (Water Discharge Control)

The requirements above shall apply. The Contractor shall also construct, maintain, and backfill adequate settlement basins for water discharge control.

PART 2 PRODUCTS

2.1 PERMANENT SHEET PILING

The piling shall be of equivalent section to that shown on the plans, and shall include all necessary waling and bracing. Steel sheet piling shall be new and unused conforming to the requirements of ASTM A 328 unless otherwise indicated on the plans. Stock steel may be used. The Contractor shall furnish to the Contracting Officer certified copies of physical and chemical test results which shall include a sworn statement by a qualified mill representative to the effect that the subject material conforms to the requirements of the steel specified. Sheet pile accessories shall conform to ASTM A 36. High strength bolts, nuts, and washers shall conform to ASTM A 325.

2.2 TEMPORARY SHEET PILING

The piling may consist of used material but must be in satisfactory condition and suitable for the intended application. The section modulus or size designation of the piling shall be not less than that shown on the plans or shop drawings. The materials shall include all necessary waling and bracing required. The Contracting Officer, may at his discretion, disapprove and reject materials which he regards to be unsound.

2.3 COFFERDAMS

The materials shall be steel sheet piling of a quality equivalent to that specified above or as otherwise indicated on the plans.

PART 3 EXECUTION

3.1 GENERAL

Steam, pneumatic, or diesel powered hammers shall be used to drive all piling. Well in advance of beginning any sheet pile installation so as to avoid delays to piling operations, probing and removal of erosion protection materials shall be performed as indicated on drawing Sheets D-1 and D-3. Any material which stops the driving of sheet piling shall be removed by the Contractor or the alignment of the sheeting altered, as directed by the Contracting Officer.

3.2 TEMPORARY SHEET PILING

The requirements above shall apply with the following addition. Unless otherwise shown on the plans, upon completion of the structure, the Contractor may, at his option, remove the sheet piling placed under this work, or leave the same in place after cutting off the tops at the elevation ordered by the Contracting Officer.

3.3 COFFERDAMS

Cofferdams shall be constructed so as to keep the excavations free from earth, water, ice, or snow and to permit the excavations to be carried to depths up to 3 feet below the foundation elevations shown on the plans. Steel sheet piling shall have adjacent sheets interlocked. In the event that permanent or temporary sheet piling is required by the plans at the location of the cofferdam, the Contractor may elect to incorporate this material into the cofferdam system. Additional bracing may be required to satisfactorily perform excavation, unwatering, and other required construction operations. The permanent sheeting system shall be returned to its intended condition after all cofferdam equipment and material, including any additional bracing, has been removed. All damage done to the temporary system, if still required, or permanent sheeting, shall be repaired at the Contractor's expense, to the satisfaction of the Contracting Officer.

Unless otherwise indicated on the plans, cofferdams shall be maintained in an unwatered condition during foundation construction. The placement of foundation concrete shall not be impeded by water standing or flowing within the cofferdam. Unwatering equipment and any necessary bracing shall be of adequate quality and capacity and shall be so arranged as to permit their proper functioning in connection with the cofferdam. Unwatering equipment and bracing shall be so located to permit construction of the structure in accordance with the plans. The cofferdam system shall be of sufficient size and strength to meet the requirements of Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction (OSHA). All damage caused by the failure of a cofferdam to perform its proper functions or from any cause whatsoever shall be the responsibility of the Contractor. It shall also be the Contractor's responsibility to protect all stream banks from erosion by reason of restriction of the channel caused by the erection of the cofferdam. All material which erodes from the banks during the time that the cofferdam is in place shall be replaced by the Contractor at his own expense. The Contracting Officer shall be the sole determiner of the nature and extent of damage. He shall approve all repair methods proposed by the Contractor.

It shall be the Contractor's responsibility to place the cofferdam so that it will not interfere with any new or existing features of work. When water discharge control is required by the plans or by the regulating agency or applicable permit, the Contractor shall construct a settlement basin, if necessary, to retain the discharge for a sufficient period of time in order that the discharge entering the stream will be as clear as the flowing stream. Prior to beginning construction of any cofferdam, the Contractor shall submit to the Contracting Officer, for review and approval, the methods he will employ.

-- End of Section --

SECTION 02414

SOIL ANCHORS
04/98
Great Bridge Culvert Bridge Replacement

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 416	(1990) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 421	(1990) Uncoated Stress Relieved Steel Wire for Prestressed Concrete
ASTM A 722	(1990) Uncoated High Strength Steel Bar for Prestressing Concrete
ASTM A 779	(1990)Steel Strand, Seven-Wire, Uncoated, Compacted, Stress-Relieved for Prestressed Concrete

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI Mnl-116S	Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI Jr 119	Recommended Practice for Grouting of Post-Tensioned Prestressed Concrete

1.2 GENERAL REQUIREMENTS

The work includes provisions of permanent prestressed pressure grouted soil anchors as the anchorage system for the bulkhead indicated on drawings.

1.2.1 Design, Installation, and Testing

Design, installation, and testing of the soil anchors shall be the Contractor's responsibility. In addition, Contractor shall design the wale as necessary to accommodate the Contractor's approved soil anchor design. Design of wale shall be in accordance with the 1996 AASHTO Standard Specifications for Highway Bridges.

1.2.2 Qualification of Installers

Installation of soil anchors shall be done only by persons who are normally engaged in work of this type, and who can furnish proof of having done satisfactory work of this nature for a minimum of three years. Certification shall be submitted, listing the proposed installers training, experience, satisfactorily completed work of similar nature, and facilities and equipment available to do the work. No materials for soil anchor installation shall be delivered to the site until the certificate has been submitted and approved.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL DESCRIPTIONS:

SD-01 Data

Calculations; GA.

Calculations indicating minimum forces required, prestressing losses, required bonded and unbonded anchor lengths, ultimate soil capacity, minimum required grout pressure, and transfer load to obtain the design load. Calculations for Contractor-proposed alternative wale design or soil anchor modification as applicable.

SD-04 Drawings

Anchorage Components; GA.

Shop drawings showing all details and specifications of the anchorage components, encapsulated protection system, weldments at the sheet piling, the anchor strands, stressing length, and bond length.

SD-06 Instructions

Installation; GA.

Stressing sequence, including height of fill necessary to avoid overstressing the sheet piling, wale, and weldments. Temporary stresses in these members shall not exceed 1.33 times the stresses normally allowed for permanent construction.

Grouting; GA.

Grout mix design and grouting sequence, including a description of equipment and methods of grouting proposed. Grout quantities and pressures for each anchor.

SD-13 Certificates

Qualifications; GA.

Certificate attesting qualification of installer as specified in paragraph QUALIFICATION OF INSTALLER.

Product Compliance; FIO.

Certificates of compliance for tie back tendons, anchorages, bearing plate, couplers, cement, and grease.

SD-18 Records

Field Test Results; FIO.

Certified copies of Performance Tests and Proof Tests indicating loads and resulting movement per increment of time with corresponding anchor location indicated on a plan.

PART 2 PRODUCTS

2.1 MATERIALS

All components of the soil anchor system shall be designed by the Contractor. The design shall be performed by a registered Professional Engineer holding a valid license to practice in the Commonwealth of Virginia. Materials shall be as required for the indicated and specified conditions and as specified below.

2.1.1 Wales

The wales shall be constructed of reinforced concrete with a 28 day compressive strength of not less than 4000 psi.

2.1.2 Tie Back Tendons

Tieback tendons shall be fabricated from single or multiple elements of the following:

2.1.2.1 Steel Bars

Steel bars conforming to ASTM A 722.

2.1.2.2 Seven-Wire Strand

Seven-wire strand conforming to ASTM A 416.

2.1.2.3 Wires

Wires conforming to ASTM A 421.

2.1.2.4 Compact Seven-Wire Strands

Compact Seven-Wire Strands conforming to ASTM A 779.

2.1.3 Anchorages

Anchorages shall be capable of developing 95 percent of the guaranteed minimum ultimate tensile strength of the prestressing steel.

2.1.4 Bearing Plate

The bearing plate shall be fabricated from mild steel and it shall be capable of developing 95 percent of the guaranteed minimum ultimate tensile strength of the prestressing steel.

2.1.5 Couplers

Prestressing steel couplers shall be capable of developing 100 percent of the ultimate strength of the prestressing steel.

2.1.6 Centralizers

Centralizers shall be fabricated from material which is nondetrimental to the prestressing steel. The centralizer shall position the tendon in the drill hole so a minimum of 0.5 inch of grout cover is provided.

2.1.7 Spacers

Spacers shall be used to separate elements of multi-element tendons. They shall be fabricated from material which is nondetrimental to the prestressing steel. A combination centralizer-spacer can be used.

2.1.8 Cement

Acid resistant cements shall be used for grout. Cement should be fresh and shall not contain any lumps or other indications of hydration.

2.1.9 Water

Water for mixing grout shall be potable.

2.1.10 Admixtures

Accelerators shall not be used. Expansive admixtures shall only be used for secondary grouting and filling trumpets and anchorage covers. Admixtures which control bleed and retard set may be used. Additives shall be mixed and placed in accordance with the manufacturer's recommendation.

2.1.11 Sheath

The tendon sheath shall be either PVC, polyethylene, or polypropylene. The sheath shall surround individual tendon elements. The material shall be capable of withstanding damage during shipping, handling, and installation.

2.1.12 Encapsulation Tube

The encapsulation tube shall be either PVC, polyethylene, or polypropylene. The tube shall be corrugated in the bonded length and smooth in the unbonded length.

2.1.13 Grease

Grease injected under the sheath shall be formulated to provide lubrication and inhibit corrosion. The chlorides, nitrates, and sulfides present in the grease shall not exceed the following limits:

a. Chlorides - 10 ppm.

b. Nitrates - 10 ppm.

c. Sulfides - 10 ppm.

PART 3 EXECUTION

The work conducted under this section shall be coordinated and accomplished in accordance with requirements indicated and specified for demolition, piling, and roadway embankment construction, and with the approved Work Plan required by SECTION 02411 SHEET PILING AND COFFERDAMS.

3.1 DESIGN LOAD

The Contractor shall design the soil anchors using the design loads indicated on the contract drawings. In no case shall anchors be spaced closer than 4 feet on center except for anchors immediately adjacent to a construction joint. Anchor tendons for proof test anchors shall be sized such that the anchor design load does not exceed 60 percent of the guaranteed ultimate tensile strength of the tendon.

3.2 MINIMUM UNBONDED AND BONDED LENGTHS

Anchors shall be of sufficient length to develop the required anchor capacity. Minimum vertical cover over bonded length of anchor shall be 15 feet. In no case shall the bonded (anchor)length be less than 20 feet. The tieback shall be installed at an angle of between 15 and 35 degrees from the horizontal. A tolerance of (+/-) 3 degrees will be permitted on the angle of inclination.

3.3 CORROSION PROTECTION

An encapsulated tieback tendon with double corrosion protection is required. Details are shown at the end of this section of the specifications and are intended to show the general arrangement of the encapsulated tendon. The bonded length shall be encapsulated in a corrugated plastic tube. The capsule must be:

a. Capable of transferring stresses from the encapsulation grout to the anchor grout.

b. Capable of accommodating movement during testing and after lock-off.

c. Resistant to chemical attack from aggressive environments, grout, or grease.

d. Fabricated from materials nondetrimental to the tendon.

e. Capable of withstanding abrasion, impact, and bending during handling and installation.

f. Leak proof.

The tendons shall be centralized inside the capsule. Cement grout shall be used to secure the tendon inside the capsule. A leak tight transition shall be provided between the bonded length encapsulation tube and the unbonded length encapsulation tube. A heat shrinkable sleeve or other suitable splices shall be used. The tendons shall be greased and sheathed in the unbonded length of the anchor and grout used to fill the annular space between the tendon and the plastic tube. The plastic tube in the unbonded length must be:

a. Capable of accommodating movement during testing and after lock-off.

b. Resistant to chemical attack from aggressive environments, grout, or grease.

c. Fabricated from materials nondetrimental to the tendon.

d. Capable of withstanding abrasion, impact, and bending during handling and installation.

e. Leak proof.

A plastic trumpet shall be used to make the transition from the bearing plate to the protection over the unbonded length. A tight fitting seal shall be provided at the end of the trumpet. The anchorage shall be covered by a protective steel cap filled with anticorrosion grease or grout.

3.4 TENDON FABRICATION

3.4.1 Prestressing Steel

Prestressing steel shall be protected from dirt, rust, or deleterious substances.

3.4.2 Tendons

Tendons can be either shop or field fabricated. Tendons shall be stored and handled in such a manner as to avoid damage or corrosion.

3.5 INSTALLATION

3.5.1 Drilling

Auger drilling, rotary drilling, or percussion driven casing can be used for soil tiebacks. The method chosen shall be compatible with the soil conditions encountered and with the approved anchor design. If driven casing is used, the casing shall be withdrawn as the grout is placed. The drill hole shall be located within 3 inches of the desired location.

3.5.2 Stressing

Stressing shall generally be accomplished in accordance with the PCI Mnl-116S "Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products."

3.5.3 Grouting

Grouting operations shall generally be in accordance with the PCI Jr 119 "Recommended Practice for Grouting of Post-Tensioned Prestressed Concrete."

3.5.4 Anchor Grout

The anchor grout shall have a water-cement ratio between 0.35 and 0.50. the grouting equipment should include a mixer capable of producing a grout free of lumps and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge to monitor grout pressures. The grouting equipment shall be sized to enable the tieback to be grouted in one continuous operation. Neat cement grouts should be screened to remove lumps. The maximum size of the screen openings shall be 0.250 inches. Mixing and storage times should not cause excessive temperature build in the grout. The mixer should be capable of continuously agitating the grout.

The anchor grout shall be injected from the lowest point of the tieback. The grout may be placed using grout tubes, casing, or drill rods. The grout can be placed before or after insertion of the tendon. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive heave.

3.5.5 Tieback

The tieback shall remain undisturbed for a minimum of three days or until the grout has reached its design compressive strength.

3.6 TESTS

Three initial anchors shall be installed and performance tested before any further installation. Each anchor shall be tested. Performance tests shall be performed on at least 10 percent of the anchors installed after the initial three, i.e., the initial three shall not be included in this percentage. Performance tested anchors, with the allowable exception of the initial three, shall not be grouped or placed consecutively for convenience, but rather located at approximately equal spacing.

3.6.1 Performance Tests

The performance test shall be performed by incrementally loading and unloading the anchor in accordance with the following schedule. At each increment, the movement of the end of the anchor shall be recorded with a dial indicator that will read accurately to 0.001 in. and the load maintained until the rate of movement is clearly approaching zero and the change in the last five minute interval is less than 0.01 in. Movement at the maximum test load shall be less than 0.04 inches to be considered successful. The increments of load shall be (D.L. = Design Load): 0 tons, 2 tons, .25 DL, 2 tons, .25 D.L., .50 D.L., .25 D.L., 2 tons, .25 D.L., .50 D.L., .75 D.L., .50 D.L., .25 D.L., 2 tons, .25 D.L., .50 D.L., .75 D.L., 1.00 D.L., .75 D.L., .50 D.L., .25 D.L., 2 tons, .25 D.L., .50 D.L., .75 D.L., 1.00 D.L., 1.20 D.L., 1.00 D.L., .75 D.L., .50 D.L., .25 D.L., 2 tons, .25 D.L., .50 D.L., .75 D.L., 1.00 D.L., 1.20 D.L., 1.33 D.L., 1.20 D.L., 1.00 D.L.

3.6.2 Proof Tests

The lock-off load is the load on the jacks which is maintained while the nuts on the anchors are tightened. The proof test shall be performed by incrementally loading the anchor in accordance with the following schedule. At each increment the movement of the end of the anchor shall be recorded with a dial indicator that will read accurately to 0.001 in. and the load maintained until the rate of movement is clearly approaching zero and the change in the last five-minute interval is less than 0.01 in. Movement at the maximum test load shall be less than 0.04 inches to be considered successful. The increment of load shall be 0 tons, 2 tons, .25 D.L., .50 D.L., .75 D.L., 1.00 D.L., 1.20 D.L., 1.33 D.L.,1.20 D.L., Lock-Off Load.

3.6.3 Lift Off Tests

Lift off tests shall be performed on each installed and tested anchor by applying load to the locked off anchor until the nut or wedge is freed from its seat. Any anchor on which the nut or wedge is freed at a load less than the design load shall be retensioned as required.

3.6.4 Anchors

Any anchor which cannot be successfully tested to the loads required in this schedule can only be incorporated in the structure using one-half of the load which it will hold without continuous movement. Additional anchors will be installed for the difference between the design load and the reduced capacity of the first anchor. The Contractor may also choose to remove the deficient anchor and replace it with an anchor meeting the above requirements. All soil anchor work shall be included in the original bid price and there shall be no additional cost to the Owner for unsuccessful tests. Arrangements of measuring devices shall be approved by the Contracting Officer and Contracting Officer shall have access to observe the instrumentation during the test period.

3.6.5 Acceptable Criteria

The Contractor shall investigate the anchor test results and determine whether the anchor is acceptable, and shall submit the certified results and conclusions to the Contracting Officer. An anchor shall be acceptable if:

a. The anchor resists the maximum test load with less than 0.04 inch of movement between 1 minute and 10 minutes; and

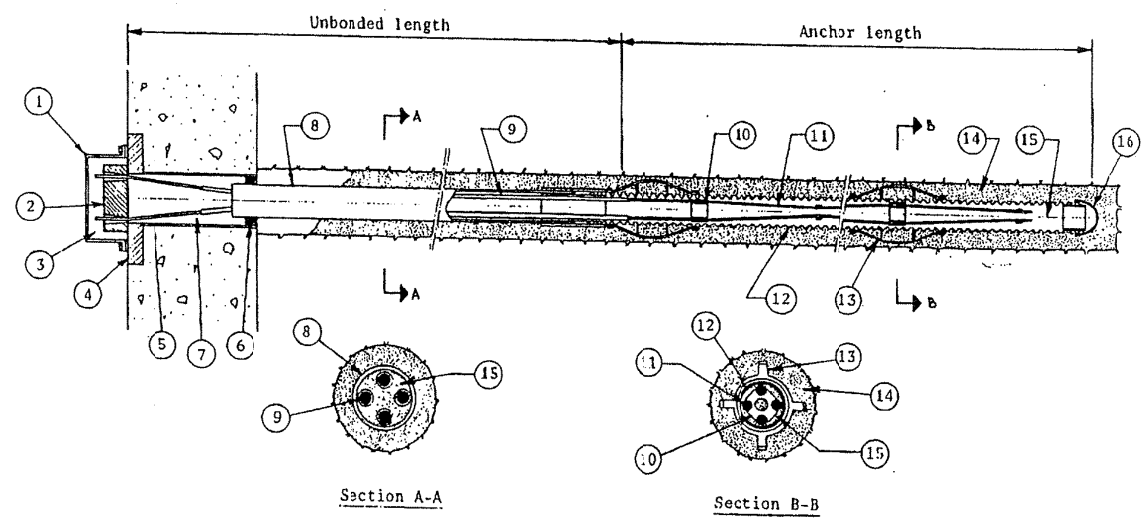
b. The total elastic movement obtained from a performance test exceeds 80 percent of the theoretical elastic elongation of the stressing length and be less than the theoretical elastic elongation of the stressing length plus 50 percent of the bond length.

c. The total movement obtained from a proof test, measured between 50 percent of the design load and the test load exceeds 80 percent of the theoretical elastic elongation of the free stressing length for this respective load range.

d. The lift-off test shows an anchor within ten percent of the specified transfer load.

When a soil anchor is not acceptable, the Contractor shall modify the design and/or the installation procedures. These modifications shall be submitted with calculations to the Contracting Officer for approval and may include, but are not limited to, installing a replacement soil anchor, reducing the design load by increasing the number of soil anchors, modifying the installation methods, increasing the bond length or changing the soil anchor type. Any modification which requires changes to any structural component shall include complete details and calculations for the altered structural component in the submittal and shall be approved by the Contracting Officer. Any modifications of designed features or construction procedures shall be without additional cost to the Government. Retesting of any soil anchor will not be permitted, except that regrouted soil anchors may be retested.

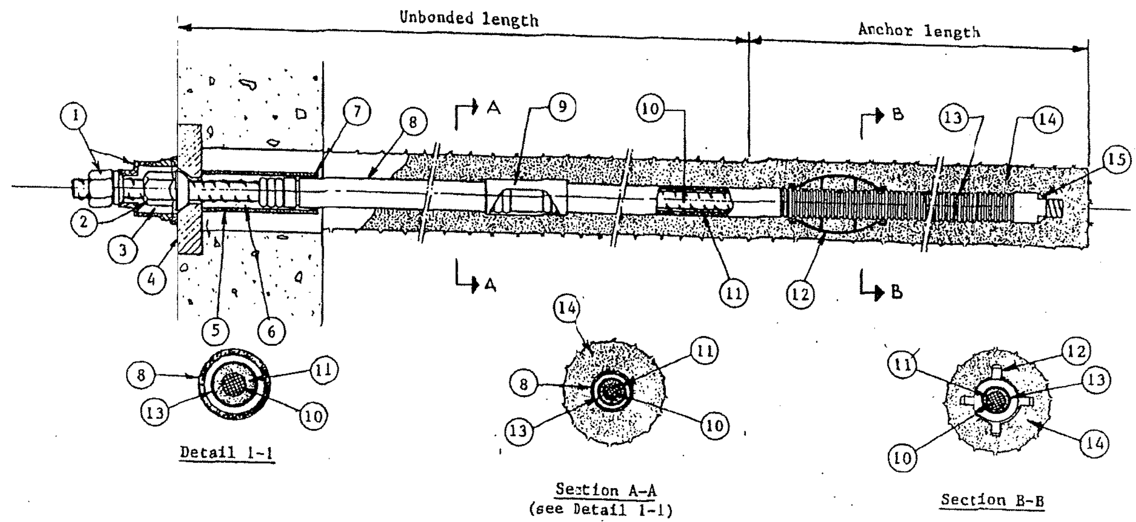
-- End of Section --



Legend:

1. Anchorage cover
2. Anchor head and wedges
3. Anticorrosion grease or grout
4. Bearing plate
5. Trumpet
6. Seal
7. Anticorrosion grease or grout
8. PVC or polyethylene tube
9. Individually greased & sheathed strands
10. Spacer
11. Strand tendon
12. Corrugated polyethylene or PVC
13. Centralizer
14. Anchor grout
15. Grout or polyester resin
16. End cap

Encapsulated strand tieback.



Legend:

1. Anchorage cover
2. Nut
3. Anticorrosion grease
4. Bearing plate
5. Trumpet
6. Anticorrosion grease or grout
7. Seal
8. PVC bond breaker
9. Protected bar coupler
10. Bar tendon
11. Encapsulation grout
12. Centralizers
13. Corrugated PVC
14. Anchor grout
15. End cap

Encapsulated bar tieback.

SECTION 02510

WATER DISTRIBUTION SYSTEM
04/98

PART 1 GENERAL

1.1 REFERENCES

This specification supplements the City of Chesapeake Public Facilities Manual (PFM) which shall govern in cases of conflict.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 88	(1996) Seamless Copper Water Tube
ASTM D 2467	(1996a) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASME INTERNATIONAL (ASME)

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1993) Ductile-Iron and Gray-Iron

	Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C153	(1994; Errata Nov 1996) Ductile-Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm) and 54 In. through 64 In. (1,400 mm through 1,600 mm) for Water Service
AWWA C500	(1993; C500a) Metal-Sealed Gate Valves for Water Supply Service
AWWA C502	(1994; C502a) Dry-Barrel Fire Hydrants
AWWA C504	(1994) Rubber-Seated Butterfly Valves
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1992) Disinfecting Water Mains
AWWA C900	(1997; C900a Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA M23	(1980) Manual: PVC Pipe - Design and Installation

ASBESTOS CEMENT PIPE PRODUCERS ASSOCIATION (ACPPA)

ACPPA Work Practices	(1988) Recommended Work Practices for A/C Pipe

CITY OF CHESAPEAKE

PFM	Public Facilities Manual Volume 1-111

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

NSF INTERNATIONAL (NSF)

NSF 14	(1998) Plastics Piping Components and Related Materials
NSF 61	(1998) Drinking Water System Components - Health Effects (Sections 1-9)

1.2 PIPING

This section covers water distribution and service lines, and connections to building service at a point approximately 5 feet outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 3 inches in diameter shall be copper tubing, unless otherwise shown or specified. Piping for water service lines 3 inches and larger shall be ductile iron, unless otherwise shown or specified.

1.2.2 Distribution Lines 3 Inches or Larger

Piping for water distribution lines 3 inches or larger shall be ductile iron, polyvinyl chloride (PVC) smaller than 12 inch, unless otherwise shown or specified.

1.2.3 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.4 Plastic Piping System

Plastic piping system components (PVC) intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.5 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02222 EXCAVATION, TRENCHING, AND

BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Plastic Pipe; GA.

Ductile-Iron Pipe; GA.

Copper Tubing; GA.

Warning Tape; GA.

PVC Pipe System; GA

PVC Pipe System (Fittings); GA.

Ductile-Iron Pipe System (Fittings); GA.

Copper Tubing System (Fittings); GA.

Plastic Pipe Jointing; GA.

Ductile-Iron Pipe Jointing; GA.

Gate Valves; GA.

Rubber Seated Butterfly Valves; GA.

Air Relief Valves; GA.

Valve Boxes; GA.

Valve Pits; GA.

Fire Hydrants; GA.

Miscellaneous Items; GA.

SD-06 Instructions

Installation; GA.

The installation submittal shall include a detailed: pipe lay schedule, sequence of construction, installation inspectors (manufacturer), statement of disposal of waste, and the manufacturer's instructions. The manufacturer's recommendations for each material or procedure to be utilized.

SD-08 Statements

Waste Water Disposal Method; GA.

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; GA.

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-09 Reports

Bacterial Disinfection; GA.

Lab Test Results for Bacterial Disinfection; GA.

Results of the Hydrostatic Test; GA.

Test results from commercial laboratory verifying disinfection.

SD-13 Certificates

Installation; GA.

A statement signed by the manufacturer's field representative certifying that the Contractor's personnel are capable of properly installing the pipe on the project.

1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.4.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the City of Chesapeake Public Facilities Manual (PFM), the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to AWWA C900 and PFM. The pipe shall be provided in standard 20 ft. lengths. Joints shall be push-on type. Solvent weld joints may not be used.

a. Pipe less than 12 inch Diameter: Pipe, couplings and fittings shall conform to AWWA C900 DR 18, Class 150, DIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

2.1.2 Ductile-Iron Pipe

Ductile-iron pipe shall conform to AWWA C151, working pressure not less than 350 psi, unless otherwise shown or specified. Thickness class of the pipe shall be Pressure Class 350. Pipe shall be cement-mortar lined in accordance with AWWA C104. Linings shall be standard. When installed underground, pipe shall be encased with polyethylene in accordance with AWWA C105. Flanged ductile iron pipe with threaded flanges shall be in accordance with AWWA C115.

Ductile iron pipe used in burried applications shall be coated with a minimum of 1 mil of bituminous coating, such as Koppers No. 50 or Interior No. 49.

2.1.3 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed.

2.1.4 Warning Tape

Install a subsurface utility warning tape at a depth of 6 to 12 inches below the finished grade for all non-ferrous water mains. The utility warning tape shall be manufactured by Griffolyn Co., or approved equal. The tape shall be made of a durable, metalized, plastic film similar to Terra Tape D for identification of water mains; bright blue tape imprinted with the legend "Caution - Waterline Below" shall be used.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

a. For pipe less than 12 inch diameter, fittings and specials shall be iron, bell end in accordance with AWWA C110, 150 psi pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

b. Ductile iron fittings used in burried applications shall be coated with a minimum of 1 mil of bituminous coating, such as Koppers No. 50 or Interior No. 49.

2.2.2 Ductile-Iron Pipe System (Fittings)

Fittings and specials shall be suitable for 350 psi pressure rating, unless otherwise specified. Fittings and specials for mechanical joint pipe shall conform to AWWA C110. Fittings and specials for use with push-on joint pipe shall conform to AWWA C110 and AWWA C111. Fittings and specials for grooved and shouldered end pipe shall conform to AWWA C606. Fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Ductile iron compact fittings shall conform to AWWA C153.

a. Ductile iron fittings used in burried applications shall be coated with a minimum of 1 mil of bituminous coating, such as Koppers No. 50 or Interior No. 49.

2.2.3 Copper Tubing System (Fittings)

Fittings and specials shall be flared and conform to ASME B16.26.

2.3 JOINTS

2.3.1 Plastic Pipe Jointing

2.3.1.1 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.3.2 Ductile-Iron Pipe Jointing

a. Mechanical joints shall be of the stuffing box type and shall conform to AWWA C111.

b. Push-on joints shall conform to AWWA C111.

c. Rubber gaskets and lubricants shall conform to the applicable requirements of AWWA C111.

d. Flanged joints shall conform to AWWA C115.

2.3.3 Copper Tubing Jointing

Joints shall be compression-pattern flared and shall be made with the specified fittings.

2.4 VALVES

2.4.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 350 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counter clockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall conform to City of Chesapeake PFM Technical Specifications

b. Double disc gate valves shall be used for pipelines from 4 inches up to and including 10 inches in diameter, and shall conform to AWWA C500.

c. Gate valves shall be double disc type, iron body, non-rising bronze stem, with an o-ring stuffing box and shall be suitable for buried service.

d. Gate valves shall be American Darling No. 55, Smith "Hydrogate", Mueller A2380, Kennedy or equal.

2.4.2 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall be used on pipelines 12 inches and larger in diameter, and shall conform to the performance requirements of AWWA C504. Unless otherwise indicated, butterfly valves shall be shortbody, Class 150B and suitable for buried service. Manual operators shall be of the traveling nut or worm gear type, sealed, gasketed, and lubricated for underground service.

The valve shall be operable with a minimum input of 150-foot pounds on the operating nut, and capable to withstand an overload input torque of 450-foot pounds at full open and full closed positions without damage to the operator or valve. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Valves shall meet the requirements as listed in the City of Chesapeake PFM Technical Specifications. Valves shall be American Darling Class 150, Mueller "Lineseal III", Kennedy "ADAP-TORQ", M&H Valve, or equal.

2.4.3 Air Relief Valves

Air relief valves shall conform to City of Chesapeake PFM Technical Specifications

2.5 VALVE BOXES

Valve boxes shall conform to City of Chesapeake PFM Technical Specifications.

2.6 VALVE PITS

Valve pits shall be constructed at locations indicated or as required above and in accordance with City of Chesapeake PFM Technical Specifications.

2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 and shall conform to City of Chesapeake PFM Technical Specifications.

2.8 MISCELLANEOUS ITEMS

Miscellaneous items shall conform to the City of Chesapeake PFM. Items include but are not limited to service saddles, corporation stops, angle curb stops, angle flanged valves, meter boxes & vaults, and tapping sleeves.

2.9 DISINFECTION

Disinfection shall be in accordance to the following:
Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION

Pipeline installation shall be as per City of Chesapeake PFM Technical Specifications. In any situation where a conflict exists, the City of Chesapeake PFM shall govern.

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

All cut edges shall be ground smooth and all burrs shall be removed. For push-on type connections, cut edges shall be slightly beveled on the outter edge. Any coatings or linings damaged during the cutting operation shall be repaired prior to installation.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 18 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 10 feet each side of the crossing, shall be water quality pipe. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main unless water quality pipe is used for the sewer lines.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with gas lines, fuel lines, or electric wiring. Water lines shall not be laid in the same trench with sewer lines, unless the sewer line is water quality pipe.

3.1.2.3 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches shall be maintained between pipes.

3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 80% of the manufacturer's allowance deflection for the type of joint used.

3.1.3.2 Allowable for Ductile-Iron Pipe

The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

Under no circumstances shall the deflection exceed 80% of the manufacturer's allowable deflection for the type of joint used.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Plastic Pipe Installation

PVC pipe shall be installed in accordance with AWWA M23 and in accordance with City of Chesapeake PFM Technical Specifications.

3.1.4.2 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.3 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.4.4 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.5 Jointing

Both ends of the pipes to be connected shall be thoroughly cleaned to remove all rust and foreign matter.

3.1.5.1 PVC Plastic Pipe Requirements

a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F 477 and as specified. Pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

b. Pipe 4 through 12 inch diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 4 inch diameter with configuration using elastomeric ring gasket.

3.1.5.2 Ductile-Iron Pipe Requirements

Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines or AWWA C606 for grooved and shouldered pipe above ground or in pits.

3.1.5.3 Copper Tubing Requirements

Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal-to-metal contact.

3.1.5.4 Transition Fittings

Connections between different types of pipe and accessories shall be made with transition fittings approved by the Contracting Officer.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 5 feet outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with City of Chesapeake PFM Technical Specifications:

3.1.7 Setting of Fire Hydrants, Meters, Valves and Valve Boxes

3.1.7.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 6 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 square inches. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

Newly installed fire hygrants not yet in service shall be covered with a bag or sheet material, securely tied in place; indicating to fire fighters that hydrant is not yet operational. Cover shall be removed once the hydrant has been placed in service.

3.1.7.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.7.3 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.7.4 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.8 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.9 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be both thrust blocks and restrained joints.

3.1.9.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.9.2 Restrained Joints

For ductile-iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design.

3.2 HYDROSTATIC TEST

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved. Tests shall comply with all requirements listed in the City of Chesapeake PFM Technical Specifications. The Contractor shall provide the results of the hydrostatic test.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 2 hours to a hydrostatic pressure test of 225 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted concurrently with the pressure tests . The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 225 psi pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 225 psi. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L = 0.0001351ND(P raised to 0.5 power)

L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of the pipe in inches
P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

Testing procedures and order shall be in accordance with the City of Chesapeake PFM Technical Specifications.

Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

3.3 BACTERIAL DISINFECTION

3.3.1 Lab Test Results for Bacterial Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 02512
ASPHALT CONCRETE PAVEMENT (VDOT)

10/01

PART 1 GENERAL

1.1 REFERENCES

The following issues of the standard(s) listed below but referred to thereafter by basic designation only, forms a part of this specification to the extent indicated by the references thereto:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 977	(2000) Standard Specification for Quick Lime and Hydrated Lime for Soil Stabilization
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 5821	(2001) Standard Test Method for Determining the Percentage of Fracture Particles in Coarse Aggregate

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 30	(1993; R 1998) Mechanical Analysis of Extracted Aggregate
AASHTO T 48	Flash and Fire Points by Cleveland Open Cup
AASHTO T 166	(2000) Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
AASHTO T 170	Recovery of Asphalt from Solutions by Abson Method
AASHTO T 176	(2000) Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
AASHTO T 201	Kinematic Viscosity of Asphalts
AASHTO T 209	(1999) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

AASHTO T 283	Resistance of Compacted Bituminous Mixture to Moisture Induced Damage
AASHTO T 304	(1996) Uncompacted Void Content of Fine Aggregate
AASHTO PP 2	(1999) Standard Practice for Mixture Conditioning of Hot Mix Asphalt (HMA)
AASHTO PP 28	(1999) Practice for SuperPave Volumetric Design for Hot Mix Asphalt (HMA)
AASHTO TP 4	Preparing and Determining the Density of HMA Specimens by the SHRP Gyratory Compactor
AASHTO MP-1	(1998) Provisional Specification for Performance Graded Asphalt Binder

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(January 1994) Road and Bridge Specifications
VTM-10	Determining Percent of Moisture and Density Using the Nuclear Moisture Density Gauges
VTM-22	Field Determination of Percent Density of Compacted Asphalt Concrete Mixtures
VTM-32B	Depth Test of Asphalt Concrete Base Course
VTM-36	Quantitative Extraction of Bitumen from Asphalt Paving Mixtures by the Reflux Method
VTM-76	Control Strip Density and Roller Pattern and Control Strip Procedure Using A Thin-Left Nuclear Density Gauge for Asphalt Concrete Surface and Intermediate Mixtures
VTM-81	Thin-Lift Nuclear Density Gauge Performance Requirements
VTM-102	Determination of Asphalt Content from Asphalt Paving Mixtures by the Ignition Method
VTM-110	Method of Test for Determining Rutting Susceptibility Using the Asphalt Pavement

Analyzer

1.2 SUBMITTALS

Government approval is required for submittals with a 'GA' designation; submittals having a 'FIO' designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Calculations; GA.

For each course, provide calculations of theoretical maximum specific gravity per VDOT RBS. The mean of the thickness of each course of each lot. All calculations shall be delivered to the Contracting Officer (CO) by the close of business on the day following completion of the respective work.

SD-09 Reports

Asphalt Concrete Mix Design; FIO.
Tests; GA.

Copies of test reports. Mix design.

SD-13 Certificates

VDOT SUPERPAVE Level I Mix Design Technician Certification; GA
VDOT Asphalt Plant Certified Technician Certification; GA

1.3 TESTING

All testing and sampling of plant mixtures and the completed asphalt paved surfaces shall be performed by an independent recognized testing laboratory at the expense of the Contractor. The testing laboratory shall submit three copies of all laboratory and field test reports directly to the Contracting Officer within 48 hours of the completion of the test.

1.4 TERMINOLOGY

All references in VDOT RBS to "Engineer" or "Department" shall mean the CO or his authorized representative.

1.5 DESCRIPTION

This work shall consist of constructing one or more courses of asphalt concrete on the prepared foundation in accordance with the requirements of these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or as established by the Contracting Officer.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE

2.1.1 General

Asphalt concrete pavement shall conform to the requirements for as specified in VDOT RBS, the Contract Drawings and except as modified herein.

2.1.2 Description

Asphalt concrete shall consist of a combination of mineral aggregate and asphalt material mixed mechanically in a plant specifically designed for such purpose.

An equivalent single axle load (ESAL) will be established by the Contracting Officer and SUPERPAVE mix types may be specified as one of the types listed as follows:

Mix Type	Equivalent Single Axle Load (ESAL) Range (millions)	Asphalt Performance Grade (PG)	Aggregate Nominal Maximum Sieve in. *
SM-9.0 A	0 to 3	64-22	3/8"
SM-9.0 D	3 to 10	70-22	3/8"
SM-9.0 E	Above 10	76-22	3/8"
SM-9.5 A	0 to 3	64-22	3/8"
SM-9.5 D	3 to 10	70-22	3/8"
SM-9.5 E	Above 10	76-22	3/8"
SM-12.5 A	0 to 3	64-22	1/2"
SM-12.5 D	3 to 10	70-22	1/2"
SM-12.5 E	Above 10	76-22	1/2"
IM-19.0 A	Less than 10	64-22	3/4"
IM-19.0 D	10 and above	70-22	3/4"
BM-25.0	All ranges	64-22	1"
BM-37.5	10 and above	64-22	1 1/2"

Asphalt concrete shall conform to the requirements for the type designated.

* Nominal Maximum Size is defined as one sieve size larger than the first sieve to retain more than 10 percent aggregate.

2.1.3 Materials

Section 211.02 except:

a. Asphalt materials shall conform to the requirements of VDOT RBS Section 210 except asphalt cement materials shall be Performance Graded (PG) conforming to the requirements of AASHTO Provisional Specification MP-1.

b. Coarse aggregate shall be Grade A or B, conforming to all requirements (except grading) of VDOT RBS Section for quality. In addition, the coarse aggregate sizes retained on and above the No. 4 sieve shall meet the coarse aggregate requirements in the aggregate properties table below. Flat and Elongated (F&E) shall be tested in accordance with ASTM D 4791 and coarse aggregate angularity (CAA) shall be tested, on crushed gravel only, in accordance with ASTM D 5821.

c. Fine aggregate shall conform to the requirements (except grading) of VDOT RBS Section 202 for quality and the fine aggregate requirements in Table 1. Fine aggregate angularity (FAA) shall be tested in accordance with AASHTO T 304 (Method A) and sand equivalent (SE) in accordance with AASHTO T 176.

TABLE l
Aggregate Properties

	Coarse Aggregate Properties			Fine Aggregate Properties	
	Coarse Aggregate Angularity (CAA)				
	1 fractured	2 fractured	F&E		
Mix Type	Face	Faces	Percent by weight	SE	FAA
SM-9.0 A	85% min.	80% min.	10% Max*	40% min.	40% min.
SM-9.0 D	85% min.	80% min.	10% Max*	45% min.	45% min.
SM-9.0 E	95% min.	90% min.	10% Max*	45% min.	45% min.
SM-9.5 A	85% min.	80% min.	10% Max*	45% min.	45% min.
SM-9.5 D	85% min.	80% min.	10% Max*	45% min.	45% min.
SM-9.5 E	95% min.	90% min.	10% Max	45% min.	45% min.
SM-12.5 A	85% min.	80% min.	10% Max	45% min.	45% min.
SM-12.5 D	85% min.	80% min.	10% Max	45% min.	45% min.
SM-12.5 E	95% min.	90% min.	10% Max*	45% min.	45% min.
BM-19.0 A	85% min.	80% min.	10% Max	45% min.	45% min.
BM-19.0 D	95% min.	90% min.	10% Max*	45% min.	45% min.
BM-25.0	80% min.	75% min.	10% Max*	45% min.	45% min.
BM-37.5	80% min.	75% min.	10% Max	45% min.	45% min.

* 10 percent measured at 5:1 on maximum to minimum dimension.

d. After performing a gradation:

1. If 10 percent or more of the material is retained on the No. 4 sieve, then that portion will be tested in accordance with 2.1.2 (b) herein.

2. If 10 percent or more of the material passes the No. 4 sieve, then that portion will be tested for Sand Equivalent.

3. If 10 percent or more of the material passes the No. 8 sieve, then that portion will be tested for Fine Aggregate Angularity.

e. Fine or coarse aggregates that tend to polish under traffic will not be permitted in any final surface exposed to traffic except in areas where the two-way average daily traffic is less than 750 vehicles per day and as permitted elsewhere in these specifications.

f. Mineral filler shall conform to the requirements of VDOT RBS Section 201.

g. Aggregate for asphalt concrete shall be provided in sufficient sizes to produce a uniform mixture. The Contractor shall indicate on the proposed job-mix formula the separate approximate sizes of aggregate to be used.

Where segregation or non-uniformity is evident in the finished pavement, the Contracting Officer reserves the right to require the Contractor to discontinue the use of crusher run or aggregate blends and to furnish separate sizes of open graded aggregate material.

h. An anti-stripping additive shall be used in all asphalt mixes. It may be hydrated lime in accordance with the requirements of 2.1.2 (i) herein or an approved chemical additive from the VDOT's approved list found in the Materials Division's Manual of Instructions, or a combination of both.

The mixture shall produce a tensile strength ratio (TSR) value not less than 0.80 for the design and production tests. The TSR value shall be determined in accordance with AASHTO T 283, including a freeze-thaw cycle, (4 inch specimens compacted with Marshall hammer or 3.5 x 6 inch specimens when compacted with a gyratory), except that the 16 hour curing time requirement and 72 to 96 hour storage period will be waived. Design tests shall use the same materials that are to be used in the production mix and shall be conducted in a VDOT approved laboratory.

When a chemical additive is used, it shall be added to the asphalt cement prior to introduction into the mix. Any chemical additive or particular concentration of chemical additive found to be harmful to the asphalt material or which changes the viscosity of the original asphalt cement more than 400 poises or the penetration more than -4 or +10 shall be changed to obtain compliance with these values.

i. Hydrated lime shall conform to the requirements of ASTM C 977. Hydrated lime shall be added at a rate of not less than 1 percent by weight of the total dry aggregate.

A separate bin or tank and feeder system shall be provided to store and accurately proportion the lime into the aggregate in either dry or slurry form. The lime and aggregate shall be mixed by pugmill or other approved means to achieve a uniform lime coating of the aggregate prior to entering the drier. In the event lime is added in dry form, the aggregate shall contain at least 3 percent free moisture. The stockpiling of lime treated aggregate will not be permitted.

The feeder system shall be controlled by a proportioning device, which shall be accurate to within ± 10 percent of the specified amount. The proportioning device shall have a convenient and accurate means of calibration. A flow indicator or sensor shall be provided with the proportioning device and interlocked with the plant controls (aggregate feed or weigh system) such that production of the mixture will be maintained and, if there is a stoppage of the lime feed, interrupted.

The method of introducing and mixing the lime and aggregate shall be subject to approval by the Contracting Officer prior to beginning production.

j. Reclaimed Asphalt Pavement (RAP) material may be used as a component material of asphalt mixtures in conformance with the following:

1. Asphalt surface, intermediate, and base mixtures containing RAP shall use the PG grade of asphalt cement as indicated in Table 5.

2. The final asphalt mixture shall conform to the requirements for the type specified.

3. During the production process, RAP material shall not be allowed to contact open flame.

4. RAP material shall be handled, hauled and stored in a manner that will minimize contamination. Further, the material shall be stockpiled and used in such manner that variable asphalt contents and asphalt penetration values will not adversely affect the consistency of the mixture.

5. RAP shall be processed in such a manner as to ensure that the maximum top size introduced into the mix shall be 2 inches. The Contracting Officer may require smaller sized particles be introduced into the mix if the reclaimed particles are not broken down or uniformly distributed throughout the mixture during heating and mixing.

2.2 JOB MIX FORMULA

The Contractor shall submit for the Contracting Officer's approval, a job-mix formula for each mixture to be supplied. The job-mix formula shall be within the design range specified. The job-mix formula shall establish a single percentage of aggregate passing each required sieve, a single percentage of asphalt material to be added to the aggregate, a temperature at which the mixture is to be produced and a temperature at which the mixture is to be compacted for SUPERPAVE testing according to the requirements of AASHTO PP 28-99. Each approved job-mix formula shall remain in effect, provided the results of tests performed on material currently being produced consistently meet the requirements of the job-mix for grading, asphalt content, temperature and SUPERPAVE compaction results.

a. SUPERPAVE mixes shall be designed and controlled according to the requirements of AASHTO PP 28-99. The contractor shall have available all of the equipment outlined in AASHTO TP 4 (Section 4-6) and a VDOT certified SUPERPAVE Level I Mix Design Technician. The SUPERPAVE Gyratory Compactor (SGC) shall be one from the approved list maintained by the VDOT Materials Division. The SUPERPAVE mixes shall conform to the criteria outlined in Table 2 and Table 4. Section 7.1.2 of AASHTO PP 2-99 shall be modified such that the compaction temperature is as specified 2.3 (d) 6 herein.

The mixture shall be designed and compacted at the N design gyrations specified in Table 4. The N max requirement shall be verified as part of the design process by compacting a minimum of 2 specimens at the design asphalt content.

b. In conjunction with the submittal of a job-mix formula, the Contractor shall submit complete SUPERPAVE design test data, ignition furnace calibration data according to VTM-l02 prepared by an approved testing laboratory and viscosity data or supplier temperature recommendations for the asphalt cement if different 2.3 (d) 6 herein.

TABLE 2
Asphalt Concrete Mixtures Design Range
Percentage By Weight Passing Square Mesh Sieves (in.)

Mix Type	2	1 ½	1	¾	½	3/8	No.4	No.8	No.30	No.50	No. 200
SM-9.0 A,D,E					100	90-100	90 max	47-67			2-10
SM-9.5 A,D,E					100	90-100	90 max	32-67			2-10
SM-12.5 A,D,E				100	90-100	90 max		28-58			2-10
IM-19.0 A,D			100	90-100	90 max			23-49			2-8
BM-25.0		100	90-100	90 max				19-45			1-7
BM-37.5	100	90-100	90 max					15-41			0-6
C					100	92-100	70-75	50-60	28-36	15-20	7-9

Legend: SM = Surface Mixture; IM = Intermediate Mixture; BM = Base Mixture; C Curb Mixture

TABLE 3
Minimum And Maximum Boundaries Of Restricted Gradation

Minimum and Maximum Percent Passing
Nominal Maximum Aggregate Size

Sieve Size	3/8 min.	3/8 max.	½ min.	½ max.	¾ min.	¾ max.	1 min.	1 max.	1 ½ min.	1 ½ max.
No. 4							39.5	39.5	34.7	34.7
No. 8	47.2	47.2	39.1	39.1	34.6	34.6	26.8	30.8	23.3	27.3
No. 16	31.6	37.6	25.6	31.6	22.3	28.3	18.1	24.1	15.5	21.5
No. 30	23.5	27.5	19.1	23.1	16.7	20.7	13.6	17.6	11.7	15.7
No. 50	18.7	18.7	15.5	15.5	13.7	13.7	11.4	11.4	10.0	10.0

TABLE 4
Mix Design Criteria

Mix Type	VTM (%) Density Note 1	VFA (%) Design	Prod'tn. Note 2	Min. VMA %	Fines/A Note 3	Design	N Initial	Max	Number of Gyrations (%) at N Initial
SM-9.0 A	2.5-5.5	75-80	70-85	16	0.6-1.3	65	7	100	LE 90.5
SM-9.0 D	2.5-5.5	75-80	70-85	16	0.6-1.3	65	7	100	LE 89.0
SM-9.0 E	2.5-5.5	75-80	70-85	16	0.6-1.3	65	7	100	LE 89.0
SM-9.5 A	2.5-5.5	73-79	68-84	15	0.6-1.2	65	7	100	LE 90.5
SM-9.5 D	2.5-5.5	73-79	68-84	15	0.6-1.2	75	7	115	LE 89.0
SM-9.5 E	2.5-5.5	73-79	68-84	15	0.6-1.2	75	7	115	LE 89.0
SM-12.5 A	2.5-5.5	70-78	65-83	14	0.6-1.2	65	7	100	LE 90.5
SM-12.5 D	2.5-5.5	70-78	65-83	14	0.6-1.2	75	7	115	LE 89.0
SM-12.5 E	2.5-5.5	70-78	65-83	14	0.6-1.2	75	7	115	LE 89.0
BM-19.0 A	2.5-5.5	69-76	64-81	13	0.6-1.2	65	7	100	LE 90.5
BM-19.0 D	2.5-5.5	69-76	64-81	13	0.6-1.2	75	7	115	LE 89.0
BM-25.0	2.5-5.5	67-75	62-80	12	0.6-1.3	65	7	100	LE 89.0
BM-37.5	2.5-5.5	64-75	59-80	11	0.6-1.3	65	7	100	LE 89.0

Note 1: Asphalt content should be selected at the mid point of the VTM range.
Note 2: During production of an approved job mix, the VFA shall be controlled within these limits.
Note 3: Fines-Asphalt Ratio is based on effective asphalt content.

Asphalt surface, intermediate, and base mixtures containing RAP shall use a PG asphalt cement according to Table 5

c. Three trial blends for gradation shall be run at 1 asphalt content. No more than 1 of the trial blend gradations shall pass through the restricted zone defined in Table 3. An aggregate blend that was previously developed and approved as a job mix formula at a higher gyration level, may be used for subsequent year's mix designs which require a lower gyration level in lieu of developing three new trial blends.

d. The SUPERPAVE design test data shall include but not be limited to the following information:

1. Grading data for each aggregate component of 3 trial blends shall be submitted to the Contracting Officer. The data for the mixture will show percent passing for sieves 2", 1 1/2", 1", 3/4", 1/2", 3/8", No. 4, No. 8, No. 16, No. 30, No. 50, No. 100 and No. 200. The grading shall be reported to the nearest 1.0 percent except the No. 200 sieve shall be reported to nearest 0.1 percent.

2. The percentage of each aggregate component as compared to the total aggregate in the asphalt mixture. The specific gravity and aggregate properties for coarse and fine aggregates defined in 2.2 (b) and (c) herein, including flat and elongated properties, for each aggregate component or for the total aggregates used in the mixture shall be reported. Aggregate properties (except Sand Equivalent) shall be reported for RAP portions of a mixture. The aggregate specific gravity of RAP shall be the effective aggregate specific gravity calculated from the results of AASHTO T 209 and VTM-102.

3. The aggregate grading in the asphalt mixture shall be determined by igniting or extracting the asphalt from a laboratory prepared sample. The laboratory sample shall be batched on the basis of component percentages as indicated in (d) 2. and at the proposed job-mix asphalt content. The aggregate shall be obtained in accordance with the requirements of VTM-102 or (VTM-36 when approved). Sieves noted in (d) 1. shall be reported, beginning with the top size for that mix.

4. The following volumetric properties of the compacted mixture calculated on the basis of the mixture's maximum specific gravity determined by AASHTO T 209 (mixture must be aged in accordance with AASHTO PP 2-99) and the bulk specific gravity of the specimens determined by AASHTO T 166, Method A for each asphalt content tested. Properties shall be determined and reported in accordance with the requirements of AASHTO PP 28-99.

a. Voids in total mix (VTM)
b. Voids in mineral aggregate (VMA)
c. Voids filled with Asphalt (VFA)
d. Fines/Asphalt ratio (F/A)

5. The value of the maximum specific gravity of the asphalt mixture used in (c) 4. shall be reported to 3 decimal places.

6. The mixing and compaction temperature for testing shall be as follows:

a. For mix designation A and all Base mixes, the mix temperature shall be 300 degrees F to 310 degrees F and the compaction temperature shall be 285 degrees F to 290 degrees F.

b. For mix designation D, the mix temperature shall be 310 degrees F to 320 degrees F and the compaction temperature shall be 295 degrees F to 300 degrees F.

c. In cases involving PG 76-22 or modified binders, the temperatures shall be based on documented supplier's recommendations.

7. Field correction factor. The field correction factor is determined by subtracting the bulk specific gravity of the aggregate from the effective specific gravity of the aggregate at the design asphalt content.

e. The SUPERPAVE design test data shall be plotted on graphs provided by the software of the test equipment manufacturer and shall show that the proposed job-mix formula conforms to the requirements of the mix type.

f. A determination will be made that any asphalt concrete mixture being produced conforms to the job-mix formula approved by the Contracting Officer. The Contracting Officer will test the mixture using samples removed from production. The following tests will be run to determine the properties listed:

1. Asphalt Content VTM-102 (VTM-36 when approved)

2. Gradation AASHTO T 30

3. SUPERPAVE Properties AASHTO PP 28-99

4. Asphalt Cement Material AASHTO T 48 or AASHTO T 201

At the discretion of the Contracting Officer, the Contracting Officer in accordance with VTM-110 will perform rut testing. If the results of the rut testing do not conform to the table below, the Contracting Officer reserves the right to require adjustments to the job-mix formula:

Mix Designation	Maximum Rut Depth, mm
A	7.0
D	5.5
E, (M), (S)	3.5

In the event the Contracting Officer determines that the mixture being produced does not conform to the approved job mix formula and volumetric properties in Table 4 based on Contracting Officer's or Contractor's test results, the Contractor shall immediately make corrections to bring the mixture into conformance with the approved job-mix formula or cease paving with that mixture.

Subsequent paving operations, using either a revised or other job-mix formula which has not been verified as described herein, shall be limited to a test run of 100 to 300 tons of mixture if such material is to be placed in the limits of the Project. No further paving for the Project using that specific mixture is to occur until the acceptability of the mixture being produced has been verified using the 100 to 300 ton constraint.

Asphalt concrete mixtures used in surface, intermediate, and base courses shall conform to the following requirements when tested in accordance with the requirements of AASHTO PP 28-99:

TABLE 5
Recommended Performance Grade of Asphalt

	Percentage RAP in Mix	
Mix Type	0.0 - 20.0	Over 20.1
SM-9.0 A, SM-9.5 A, SM-12.5 A	PG 64-22	PG 5 8-28
SM-9.0 D, SM-9.5 D, SM-12.5 D	PG 70-22	PG 64-28
SM-9.0 E, SM-9.5 E, SM-12.5 E	PG 76-22	PG 70-28
IM-19.0 A	PG 64-22	PG 58-28
IM-19.0 D	PG 70-22	PG 64-28
BM-25.0	PG 64-22	PG 64-22 *
BM-37.5	PG 64-22	PG 64-22 *

* BM25.0 and BM-37.5 mixes using more than 25 percent RAP shall use a PG 58-22.

Base mixes shall have a minimum asphalt content of 4.0 percent determined by SUPERPAVE design as specified herein.

Based on rut testing performed by the Contracting Officer and/or field performance of the job-mix, the Contracting Officer reserves the right to require adjustments to the job-mix formula. Based upon a plot of aggregate grading, which indicates an aggregate grading passes through the restricted zone established by Table 5, the Contracting Officer reserves the right to require rut testing of the job-mix. Based on the rut testing, the Contracting Officer reserves the right to require adjustments in the job-mix formula.

2.3 ASPHALT CONCRETE MIXTURES

Asphalt concrete mixtures shall conform to the requirements of Table 4 and the following:

a. Types SM-9.0 A, SM-9.0 D, SM-9.0 E, SM-9.5 A, SM-9.5 D, SM-9.5 E, SM-12.5 A, SM-12.5 D, and SM-12.5 E asphalt concrete shall consist of crushed stone, crushed slag, or crushed gravel and fine aggregate, slag or stone screenings or a combination thereof combined with asphalt cement.

NOTE: For all surface mixes, except where otherwise noted, no more than 5 percent of the aggregate retained on the No. 4 sieve and no more than 20 percent of the total aggregate may be polish susceptible.

b. Types IM-19.0 A and IM-19.0 D asphalt concrete shall consist of crushed stone, crushed slag, or crushed gravel and fine aggregate, slag or stone screenings or a combination thereof combined with asphalt cement.

NOTE: At the discretion of the Contracting Officer, an intermediate mix may be designated as either a SM-19.0 A or SM-19.0 D. When designated as such, no more than 5 percent of the aggregate retained on the No. 4 sieve may be polish susceptible. All material passing the No. 4 sieve may be polish susceptible.

c. Types BM-25.0 and BM-37.5 asphalt concrete shall consist of crushed stone, crushed slag, or crushed gravel and fine aggregate, slag or stone screenings or a combination thereof combined with asphalt cement.

d. Type C (Curb Mix) Asphalt Concrete shall consist of a blend of No. 78 or No. 8 crushed aggregate, No. 10 crushed aggregate, fine aggregate, mineral filler and a stabilizing additive from VDOT's approved list; combined with 6.0-9.0 percent of PG 64-22. This mix does not require a volumetric mix design or volumetric testing under the SUPERPAVE system.

e. Asphalt mixtures Type SM-9.5, SM-12.5, IM-19.0, BM-25.0, and BM-37.5 may be designated (M) for modified, (5) for stabilized or (M) or (s) for Contractor's option. Asphalt mixtures with the E designation may be modified, but shall not be stabilized.

1. Type (M) asphalt mixtures shall consist of mixes incorporating a neat asphalt material with polymer modification meeting the requirements of a PG 76-22 and have a Rolling Thin Film Oven Test residue elastic recovery at 77 degrees F of a minimum 70 percent. Modified mixtures shall be designated with a (M) following the standard mix designation. Type (M) asphalt mixtures shall not be permitted to exceed 15 percent reclaimed asphalt pavement material.

2. Type (5) asphalt mixtures shall consist of mixes incorporating a stabilizing additive from VDOT's approved list. These mixes shall be designated with a (5) following the standard mix designation. The minimum required additive shall be as specified on the approved list.

2.4 TESTING

The Contractor shall provide the quality control and assurance necessary for the Contracting Officer to determine conformance with the required grading, asphalt content and temperature properties for asphalt concrete.

The Contractor shall have a VDOT certified SUPERPAVE Level I Mix Design Technician for designing and adjusting mixes as necessary. The SUPERPAVE Level I Mix Design Technician or Asphalt Plant Certified Technician may perform testing of asphalt mixes. The SUPERPAVE Level l Mix Design Technician will be responsible for reviewing and approving the results of all testing. The SUPERPAVE Level I Mix Design Technician shall be available and have direct communication with the plant for making necessary adjustments in the asphalt concrete mixes at the mixing plant The SUPERPAVE Level I Mix Design Technician and Asphalt Plant Certified Technician shall be capable of conducting any tests necessary to put the plant into operation and to produce a mixture within the requirements of these specifications.

Certifications are awarded by the VDOT. The cost and efforts required for acquiring certification shall be the responsibility of the Contractor. Certification shall be accomplished at least 2 months prior to the commencement of any paving operations. The Contractor shall have certified personnel available, as appropriate, throughout the duration of all paving operations including during periods of final inspection and acceptance.

The Contracting Officer will conduct on-sight inspections so the Contractor's SUPERPAVE Level I Mix Design Technician can demonstrate knowledge of SUPERPAVE mix design and production requirements.

The Contractor shall maintain all records and test results associated with the material production and shall maintain appropriate current quality control charts. All test results and control charts shall be available for review by the Contracting Officer.

The Contractor shall execute a quality control plan of process inspections and tests, including the determination of SUPERPAVE properties. The results of the SUPERPAVE tests shall be used, along with the results of other quality control efforts, to control the quality of the mixture being produced.

The Contractor shall perform at least one field SUPERPAVE test per day per mix or per 1000 tons per mix if more than 1000 tons of a mix is produced per day (aging as described in PP-2-99 shall not be performed). Field SUPERPAVE test results shall be plotted and displayed in control chart form in the plant immediately following the completion of each individual test. The tests shall determine asphalt content, VTM, VMA, VFA and F/A in percent to the nearest 0.1 percent.

Aggregate specific gravity and aggregate property tests shall be conducted by a VDOT certified SUPERPAVE Asphalt Aggregate technician on each aggregate component (including RAP) or total aggregate mixture once at design and once prior to beginning production in each calendar year. Sand Equivalent shall not be performed on RAP. Additionally, for each 50,000 tons of each aggregate size used at each plant, aggregate specific gravity and aggregate property test shall be reported on each aggregate component or the total aggregate mixture. Otherwise, if the total blend (cold feed) is used to obtain aggregate specific gravity and aggregate properties, then these tests shall be run for each 50,000 tons of the total blend.

Field SUPERPAVE tests shall be performed to N design gyrations as specified in Table 4. At the Contracting Officer's discretion, the N max requirement may be checked.

2.5 TESTS

The Contracting Officer may sample materials entering into the composition of the asphalt concrete, the mixture or the completed pavement. The Contractor shall cooperate with the Contracting Officer in obtaining these samples. When samples are obtained from the pavement, the resulting voids shall be filled and refinished by the Contractor without additional compensation.

When asphalt cement is extracted and recovered in accordance with AASHTO T 170, the recovered asphalt cement shall have the following penetration and ductility at 77 Degrees F:

Mix Type	Recovered Penetration	Ductility at 77 degrees F
SM-9.0 A, 9.5 A, 12.5 A	min. 35	min. 40 cm
SM-9.0D, 9.SD, 12.5D	min. 25	min. 40 cm
IM-19.0A	min. 35	min. 40 cm
IM-19.0D	min. 25	min. 40 cm
BM-25.0, 37.5	min. 35	min. 40 cm

NOTE: Recovered Penetration and Ductility shall not be performed on SM-9.5 E, 12.5 E, and all (M) and (5) mixes.

Abson recovery samples that fail recovered penetration or ductility shall be PG graded according to AASHTO MP-1. If the samples meet the required grade specified in 2.1.1 herein, they shall be deemed acceptable.

When the Contracting Officer performs PG grading on a Contractor's liquid asphalt storage tank, the Contracting Officer will notify the Asphalt Concrete Producer and Binder Supplier if tests indicate that the binder properties of the asphalt material differs from the approved job-mix. It will be the responsibility of the Asphalt Concrete Producer and Binder Supplier to determine corrective action with the approval of the Contracting Officer.

2.6 PLANT INSPECTION

The preparation of asphalt concrete mixtures will be accepted under a quality assurance plan. The Contractor shall provide a laboratory as specified in VDOT RBS Section 106.07.

2.7 ACCEPTANCE

Acceptance shall be made under the Contracting Officer's quality assurance program which includes the testing of production samples by the Contractor and monitor samples by the Contracting Officer. Sampling and testing for the determination of grading, asphalt cement content and temperature shall be performed by the Contractor. The Contracting Officer may also perform independent monitor checks at its discretion. The Contractor shall provide copies of such test results to the Contracting Officer on forms acceptable to the Contracting Officer. In the event the Contractor's test results indicate that the mixture conforms to the gradation, asphalt cement content and mix temperature requirements of the Specifications, the mixture will be acceptable for these properties; however, nothing herein shall be construed as waiving the requirements of VDOT RBS Sections 106.06, 200.02 and 200.03 or relieving the Contractor of the obligation to furnish and install a finished functional product which conforms to the requirements of the Contract. In the event a statistical comparative analysis of the Contractor's test results and the Contracting Officer's monitor tests indicate a statistically significant difference in the results and either of the results indicate that the material does not conform to the grading and asphalt cement content requirements of the Specifications, an investigation will be made at the Contracting Officer's discretion to determine the reason for the difference. No price adjustment will be made for materials that do not conform to the specifications and materials that do not conform with the specifications shall be removed and replaced with new work.

Acceptance for gradation and asphalt cement content will be based upon a mean of the results of four tests performed on samples taken in a stratified random manner from each 2000 ton lot (4000 ton lots may be used when the normal daily production of the source from which the material is being obtained is in excess of 2000 tons). Unless otherwise approved, samples shall be obtained from the approximate center of randomly selected quadrants of truckloads of material. Any statistically acceptable method of randomization may be used to determine the time and location of the stratified random sample to be taken; however, the Contracting Officer shall be advised of the method to be used prior to beginning production.

A lot will be considered to be acceptable for gradation and asphalt content if the mean of the test results obtained is within the tolerance allowed from the job-mix formula, as shown in Table 6.

The temperature of the mixture at the plant shall be controlled to provide load to load uniformity during changing weather conditions and surface temperatures. The maximum temperature of mix designations A and D, and base mixes, shall not exceed 350 degrees F, unless otherwise directed by the Contracting Officer. The maximum temperature as recommended by the supplier shall not be exceeded for an F, (M), or (S) designated mix.

In the event the job-mix formula is modified within a lot, the mean test results of the samples taken will be compared to the applicable process tolerance shown in Table 6.

Asphalt content will be measured as extractable asphalt or weight after ignition.

Field SUPERPAVE tests may be performed by the Contracting Officer in accordance with the requirements of AASHTO PP 28-99 during the production of the approved job- mixes designed by the SUPERPAVE method. Aging, as described in AASHTO PP 2-99, shall not be performed.

Should any Field SUPERPAVE test fail to meet the specified limits contained in Table 4, the Contracting Officer may require that production be stopped until necessary corrective action is taken by the Contractor. The Contracting Officer will, at his discretion, investigate and determine the acceptability of material placed and represented by failing Field SUPERPAVE test results.

TABLE 6
Process Tolerance

Tolerance on Each Laboratory Sieve and Asphalt Content - Percent Plus and

Number Tests	Minus Size	Top in.	1 12 in.	¾ in.	½ in.	3/8 No.4	No.8	No.30	No.50	No.200	A.C
1	0.0	8.0	8.0	8.0	8.0	8.0	8.0	6.0	5.0	2.0	0.60
2	0.0	5.7	5.7	5.7	5.7	5.7	5.7	4.3	3.6	1.4	0.43
3	0.0	4.4	4.4	4.4	4.4	4.4	4.4	3.3	2.8	1.1	0.33
4	0,0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.5	1.0	0.30
8	0.0	2.8	2.8	2,8	2.8	2.8	2,8	2.1	1.8	0.7	0.21

Note: The Top Size is defined as the sieve which has 100% passing as defined in Table 3. The Top Size tolerance for SM-9.0 and SM-9.5 mixes shall be as follows:

Number Tests	Top Size
1	2.0
2	1.4
3	1.1
4	1.0
5	0.7

Should visual examination by the Contracting Officer reveal that the material in any load or portion of the paved roadway is obviously contaminated or segregated, that load or portion of the paved roadway will be rejected without additional sampling or testing of the lot. In the event it is necessary to determine the gradation or asphalt content of the material in any load or portion of the paved roadway, samples shall be taken by the Contractor, tested, and the results compared to the requirements of the approved job-mix formula. The results obtained in the testing will apply only to the material in question.

2.8 TACK COAT

Shall conform to VDOT RBS Section 2.10.

2.9 PRIME COAT

Shall conform to VDOT RBS Sections 202, 203, 206, and 210.

PART 3 EXECUTION

3.1 INSPECTION PRIOR TO WORK

Prior to starting each paving or related operation, the Contractor shall inspect previous work and surfaces to receive new work for compliance with the drawings and specifications, and enter their condition on the daily log. Conditions to be noted include; temperature of surfaces and ambient air, standing water or ice, presence of dust on surfaces to receive work, conformance of previous work or surfaces with drawings and specifications, and other conditions required or specified.

3.2 EQUIPMENT

Shall conform to VDOT RBS Section 3.15.03.

3.3 PLACEMENT LIMITATIONS

Shall conform to VDOT RBS Section 3.15.04 EXCEPT THAT 3.15.04.2 is replaced with the following:

2. When the base temperature is between 350 degrees F and 80 degrees F, the Nomograph, Table 111-2, shall be used to determine the minimum laydown temperature of the asphalt concrete mixes. At no time should the minimum base and laydown temperatures be less than the following:

Mix Designation	Minimum Base Temperature	Minimum Laydown Temperature
A	40 degrees F	250 degrees F
D	50 degrees F	270 degrees F
E	50 degrees F	290 degrees F
M	50 degrees F	290 degrees F
S	50 degrees F	290 degrees F
All Base Mix	35 degrees F	250 degrees F

The maximum temperature of the mixture shall conform to 2.8 herein.

3.4 PROCEDURES

Shall conform to VDOT RBS Sections 3.15.05 EXCEPT THAT:

The following paragraph shall be added to the end of 3.15.05.1.b:

Tacking: Application of tack at joints, adjacent to curbs, gutters, or other appurtenances shall be applied with a hand wand at the rate of 0.2 gallons per square yard. At joints, the hand wand applied tack shall be 2 feet in width with 4 to 6 inches protruding beyond the joint for the first pass. Tack for the adjacent pass shall completely cover the vertical face of the mat edge, so that slight puddling of asphalt occurs at the joint, and extends a minimum of 1 foot into the lane to be paved. Milled faces that are to remain in place shall be tacked as above for the adjacent pass. Use of tack at longitudinal joint vertical faces will not be required when paving in echelon.

The last three paragraphs of 3.15.05.c shall be replaced with the following:

The placement of asphalt concrete shall be as continuous as possible and shall be scheduled such that the interruption occurring at the completion of each day's work will not detrimentally affect the partially completed work. Material that cannot he spread and finished in daylight shall not be dispatched from the plant unless the use of artificial lighting has been approved. When paving is performed at night, sufficient light shall be provided to properly perform and thoroughly inspect every phase of the operation. Such phases include cleaning planed surfaces, tack application, paving, compacting, and testing. Lighting shall be provided and positioned such as to not create a blinding hazard to the traveling public.

During compaction of asphalt concrete, the roller shall not pass over the end of freshly placed material except when a construction joint is to be formed. Edges shall be finished true and uniform.

Asphalt concrete SUPERPAVE pavement courses shall be placed in layers not exceeding 4.0 times the nominal maximum size aggregate in the asphalt mixture. The maximum thickness may he reduced if the mixture cannot he adequately placed in a single lift and compacted to required uniform density and smoothness. The minimum thickness for a pavement course shall be no less than 2.5 times the nominal maximum size aggregate in the asphalt mixture. Nominal maximum size aggregate for each mix shall be defined as one sieve size larger than the first sieve to retain more than 10 percent aggregate as shown in the design range specified in 2.1.3 herein, Table 3. Base courses to he placed in irregular shaped areas of pavement, such as transitions, thru lanes, crossovers, and entrances may be placed in a single lift.

Overlays in excess of 165 lbs. per square yard or a milled depth greater than 1 1/2 inches shall be squared up prior to opening to traffic.

The milled roadway areas that are to he opened to traffic, excluding curb and gutter sections, shall have drainage outlets cut through the shoulder at locations designated by the Contracting Officer. The Contractor shall plan and prosecute the milling operation to avoid the trapping of water on the roadway. Drainage outlets shall be restored to original grade, unless otherwise directed by the Contracting Officer at no additional cost to the government.

The Contractor shall plan and prosecute a schedule of operations so that milled roadways will he overlaid with asphalt concrete as soon as possible, and, in no instance, shall the time lapse exceed ten days after the milling operations, unless otherwise specified. The milled areas of the roadway shall be kept free of irregularities and obstructions that may create a hazard or annoyance to traffic in accordance with the requirements of VDOT RBS Section 104.

A short ski or shoe shall be used to match the grade of the newly overlaid adjacent travel lane on all primary, interstate and designated secondary routes. Unless otherwise directed by the Contracting Officer, a 24 foot minimum automatic grade control ski shall be used on all asphalt mixtures on all divided highways, with the exception of less than full width overlays and the first course of asphalt base mixtures over aggregate subbases. Care shall be exercised when working along curb and gutter sections to ensure a uniformed grade and joint.

The Contractor shall construct the final riding surface to tie into the existing surface by an approved method, which shall include the cutting of a notch into the pavement. In addition to notching, the Contractor may use an asphalt design containing a fine graded mix to achieve a smooth transition from the new asphalt concrete overlay to the existing pavement, with the approval of the Contracting Officer. The material shall be of a type to insure that raveling will not occur. All cost for constructing tie-ins in the asphalt concrete overlay shall be included in the price bid for asphalt concrete.

3.15.05.e shall be replaced with the following:

(e) Density: Density shall be determined in accordance with the following:

1. The Contractor shall perform roller pattern and control strip density testing on surface and intermediate courses in accordance with the requirements of VTM-76.

Density shall be determined by the backscatter method of testing using a thin-lift nuclear gauge with printer, conforming to the requirements of VTM-81. All density test locations shall be marked in accordance with the requirements of VTM-76. The Contractor shall furnish and operate the nuclear gauge, which shall have been calibrated within the previous 12 months by an approved calibration service. In addition, the Contractor shall maintain documentation of such calibration service for a 12-month period. The required density of the compacted course shall be not less than 98.0 percent and not more than 102.0 percent of the control strip density.

Nuclear density roller pattern and control strip density testing will be performed on asphalt concrete overlays placed directly on surface treatment roadways and when overlays are placed with depths less than 1 inch (nominal application rate of 125 lbs. per square yard) on any surface. In these situations, sawed plugs or core samples will not be required and the minimum control strip densities as shown in Table 8 will be waived. The required density of the compacted course shall be not less than 98.0 percent and not more than 102.0 percent of the control strip density.

The project will be divided into "control strips" and "test sections" by the Contracting Officer for the purpose of defining areas represented by each series of tests.

a. Control strip: Construction of control strips shall be accomplished in accordance with the requirements of these specifications and VTM-10.

The term control strip density is defined as the average of 10 nuclear determinations selected at stratified random locations on the control strip.

One control strip shall be constructed at the beginning of work on each roadway and shoulder course and on each lift of each course. An additional control strip shall be constructed when a change is made in the type or source of materials, or compactive equipment, or whenever a significant change occurs in the composition of the underlying pavement structure or the composition of the material being placed from the same source. Either the Contracting Officer or the Contractor may initiate an additional control strip at any time. During the evaluation of the initial control strip, paving operations may continue. However, paving and production shall be discontinued during construction and evaluation of the additional control strips.

The length of the control strip shall be approximately 300 feet regardless of the width of the course being placed. On the first day of construction or beginning of a new course, the control strip shall be started between 500 and 1,000 feet from the beginning of the paving operation. The thickness of the control strip shall be the same as the course of which it is to be a part. The control strip shall be constructed using the same paving and rolling equipment and procedures as will he used on the remainder of the course being placed. Every control strip shall remain in place and become a portion of the completed roadway. One nuclear reading shall be taken at each stratified random location. No determination will be made within 1 foot from the edge of any application width. The average of these 10 determinations will be the control strip density read to the nearest 0.1 pound per cubic foot. The minimum control strip density shall be determined in accordance with the requirements of VTM-76.

If the control strip density conforms to the requirements of Table 8, the control strip will be acceptable and the control strip density shall become the target nuclear control strip density. If the density does not conform to the requirements of Table 8, the Contractor shall change compactive efforts to produce a higher density. The Contracting Officer will evaluate the foundation conditions when an acceptable control strip density cannot be obtained, If it is determined that the required density cannot be obtained because of the condition of the existing pavement structure, the target nuclear control density will be determined from the roller pattern that achieves the optimum density and will be used on the remainder of roadway that exhibits similar pavement conditions.

TABLE 8
Density Requirements

Mixture Type	Mm. Control Strip Density (%)
SM-9.5 A, 12.5 A	97.0
SM-9.5 D, 12.5 D	96.0
SM-9.5 E, 12.5 E	96.0
IM-19.0 A	96.0
IM-19.0 D	95.0

Note: The control strip density requirement is the percentage of the compacted unit weight of the mixture, at the job-mix asphalt content and design voids, as established by the SUPERPAVE design gyrations for the mixture or as established by the Contracting Officer based on two or more field SUPERPAVE tests.

b. Test section (lot): For the purpose of acceptance, each day's production shall be divided into lots (test section). The standard size of a lot shall consist of 5,000 linear feet of any pass made by the paving train regardless of the width of the pass or the thickness of the course. Payers traveling in echelon will be considered as two passes. Each lot shall be divided into five sublots of equal length. When a partial lot occurs at the end of a day's production or upon completion of the project, the lot size shall be redefined as follows: If the partial lot contains one or two sublots, the sublots will be added to the previous lot. If the partial lot contains three or four sublots, the partial lot will be redefined to be an entire lot. Each lot shall be tested for density by taking a nuclear density reading from two random locations selected by the

Contracting Officer within each sublot. Readings shall not be taken within 1 foot of the edge of any application width. The average of the sublot nuclear density readings will be compared to the target nuclear control strip density to determine the acceptability of the lot. Once the average nuclear density of the lot has been determined, the Contractor will not be permitted to provide additional compaction to raise the average. If two consecutive sublots produce nuclear density results less than 98 or greater than 102 percent of the target nuclear control strip density, the Contractor shall immediately notify the Contracting Officer and institute corrective action. By the end of the day's operations, the Contractor shall furnish the test data developed during the day's paving to the Contracting Officer.

1. Base courses: Rollers shall move at a slow, but uniform speed with the drive roll or wheels nearest the paver. Rolling shall be continued until roller marks are eliminated and a minimum density of 9l.5 percent of the theoretical maximum density has been obtained.

Not more than one sample in every five shall have a density less than that specified, and the density of such sample shall be not more than 2 percent below the minimum specified.

Density determinations may be performed by the Contracting Officer or Contractor using a nuclear density gauge with a density control strip as specified in VDOT RBS Section 304 and VTM-l0.

3.   Surface, Intermediate and Base Courses not having sufficient quantity of material to run a nuclear density roller pattern and control strip shall be compacted to a minimum density of 92.0 percent of the theoretical maximum density as determined by VTM-22. The Contractor shall be responsible for cutting cores or sawing plugs for testing, by the Contracting Officer.

Any section having mixture (i.e. SM-9.0) being placed at a depth less than 1 inch (125 lbs. per square yard) and not having sufficient quantity to run a nuclear density roller pattern and control strip shall be compacted by rolling a minimum of 3 passes with a minimum 8 ton roller. No density testing will be required.

3.15.05.f shall be replaced with the following:

(e) Joints: Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. A coat of asphalt shall be applied to contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

Joints adjacent to curbs, gutters, or adjoining pavement shall be formed by hand placing sufficient mixture to fill any space left uncovered by the paver. The joint shall then be set up with rakes or lutes to a height sufficient to receive full compression under the rollers.

3.5 PAVEMENT SAMPLES

The Contractor shall cut samples from the compacted pavement for testing for depth and density. Samples shall be taken for the full depth of the course at the locations selected by the Contracting Officer. The removed pavement shall be replaced with new mixture and refinished. No additional compensation will be allowed for furnishing test samples and reconstructing areas from which they were taken.

3.6 PAVEMENT TOLERANCES

a. Surface Tolerance: The surface will be tested by using a 10-foot straightedge. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall be not more than 1/4 inch. Humps and depressions exceeding the specified tolerance shall be corrected, or the defective work shall be removed and replaced with new material.

b. Thickness Tolerance: The thickness of the base course will be determined by the measurement of cores as described in VTM-32B.

Acceptance of asphalt concrete base course for depth will be based on the mean result of measurements of samples taken from each lot of material placed. A lot of material is defined as the quantity being tested for acceptance except that the maximum lot size will be 1 mile of 24-foot-width base course.

A lot will be considered acceptable for depth if the mean result of the tests is within the following tolerance of the plan depth for the number of tests taken except that each individual test shall be within +0.60 inch of the plan depth: mean of two tests, ±0.45 inch; mean of three tests, ±0.35 inch; mean of four tests, ±0.30 inch.

If an individual depth test exceeds the ±0.60 inch tolerance, that portion of the lot represented by the test will be excluded from the lot. If an individual test result indicates that the depth of the material represented by the test is deficient by more than 0.60 inch, correction of the base course represented by the test shall be made as follows:

For sections of base course that are deficient in depth by more than 0.60 inch and less than 1.50 inch, the Contractor shall furnish and place material specified for the subsequent course to bring the base course depth within the tolerance. If the deficiency is more than 1.50 inches, the Contractor shall furnish and place base course material to bring the base course thickness within the tolerance. Corrections for deficient base course depth shall be made in a manner to provide a finished pavement that is smooth and uniform.

When the Contract provides for the construction or reconstruction of the entire pavement structure, the surface and intermediate courses shall be placed at the rate of application shown on the plans within an allowable tolerance of ±5 percent of the specified application rate for application rates of 100 pounds per square yard or greater and within 5 pounds per square yard for application rates of less than 100 pounds per square yard.

When the Contract provides for the placement of surface or intermediate courses over existing pavement, pavements constructed between combination curb and gutter, or in the construction or reconstruction of shoulders, such courses shall be placed at the approximate rate of application shown on the plans. However, the specified rate of application shall be altered where necessary to produce the required riding quality.

3.7 PRIME COAT

Shall conform to VDOT RBS Sections 3.10.01 and 310.03.

3.8 TACK COAT

Shall conform to VDOT RBS Sections 3.10.01 and 310.03.

-- End of Section --

SECTION 02513

TRAFFIC CONTROL DEVICES
07/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(1994) January, Road and Bridge Specifications
VWAPM	(1996) January, Virginia Work Area Protection Manual
VAMUTCD	(1980) January, The Virginia Supplement to the Manual on Uniform Traffic Control Devices for Streses and Highwasys

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP 230	Recommended Procedures for the Safety Performance Evaluation of Highway Safety Appurtenances

FEDERAL HIGHWAY ADMINISTRATION

MUTCD	(1988) Manual on Uniform Traffic Control Devices for Streets and Highways

All references to "Engineer" of "The Department" in the VDOT publications shall refer to the Contracting Officer (CO) or his authorized representative where appropriate.

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Design; GA.

The Contractor shall submit working drawings, including design calculations and catalogue cuts, in accordance with VDOT RBS Sections 505.02, 700.02, 700.03, 701.02, and 702.02 for all guardrail, conduit, junction boxes, sign structures, foundations, signs, delineators, pavement markings and markers, and appurtenances necesssary to complete the work.

The Contractor shall submit working drawings, including design calculations and catalogue cuts, in accordance with NCHRP 230 for impact attenuators and the VDOT RBS material requirements for all appurtenances necessary to complete the work.

PART 2 PRODUCTS

Products for guardrail, conduit, junction boxes, sign structures, foundations, signs, delineators, pavement markings and markers, and appurtenances shall conform to the specifications provided in VDOT RBS Sections 505.02, 700.02, 701.02, and 702.02.

Products for impact attenuators shall conform to the requirements in NCHRP 230 and the VDOT RBS.

2.1 Impact Attenuators

Impact attenuator shall be capable of absorbing and dissipating energy associated with head-on collisions and shall be capable of redirecting vehicles onto the roadway from side impacts. It shall be designed for use in construction zones and shall be compatible with traffic barrier service. Impact attenuator shall have been successfully tested in accordance with NCHRP 230.

PART 3 EXECUTION

Execution of the work shall conform to VDOT RBS Sections 505.03, 700.04, 701.03, and 702.04, the MUTCD, the VAMUTCD, the VWAPM, and NCHRP 230 .

-- End of Section --

SECTION 02531

SANITARY SEWERS
05/98

PART 1 GENERAL

1.1 REFERENCES

This specification supplements the City of Chesapeake Public Facilities Manual (PFM) which shall govern in cases of conflict.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 94	(1998) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 270	(1997ael) Mortar for Unit Masonry
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 828	(1998) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 924	(1989; R 1997) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 972	(1995) Compression-Recovery of Tape Sealant
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1784	(1999) Rigid Poly(Vinyl Chloride) (PVC)

	Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a)Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 402	(1993) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 794	(1997) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(1996a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	(1996) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

CITY OF CHESAPEAKE

PFM	Public Facilities Manual Volume 1-111

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
UBPPA UNI-B-9	(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Force mains are specified in Section 02532 FORCE MAINS. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Portland Cement; GA.

SD-04 Drawings

Plastic Pipe; GA.

Ductile Iron Pipe; GA.

Warning Tape; GA.

Fittings for Plastic Pipe; GA.

Fittings for Ductile Iron Pipe; GA.

Plastic Pipe Jointing; GA.

Ductile Iron Pipe Jointing; GA.

Branch Connections; GA.

Frames and Covers; GA.

Steps; GA.

Precast Reinforced Concrete Manhole Sections and Gaskets; GA.

Interior Coating; GA.

SD-09 Reports

Leakage Tests; GA.

Test for Deflection; GA.

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the City of Chesapeake PFM and as specified on the plans.

2.1.1 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 8 inch through 15 inch diameter.

2.1.1.1 ABS Pipe

ASTM D 2751.

2.1.1.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 23.5, Size 15 inches or less in diameter. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

2.1.2 Ductile Iron Pipe

Pipe shall conform to AWWA C151 unless otherwise shown or specified.

2.1.3 Warning Tape

Install a subsurface utility warning tape at a depth of 6 to 12 inches below the finished grade for all non-ferrous sewer mains. The utility warning tape shall be manufactured by Griffolyn Co., or approved equal. The tape shall be made of a durable, metalized, plastic film similar to Terra Tape D for identification of sewer mains; bright green tape imprinted with the legend "Caution - Sewer Below" shall be used.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

2.2.1.1 Fittings for ABS Pipe

ASTM D 2751.

2.2.1.2 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

2.2.2 Fittings for Ductile Iron Pipe

Mechanical fittings shall conform to AWWA C110, rated for 350 psi. Push-on fittings shall conform to AWWA C110 and AWWA C111, rated for 350 psi.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

2.3.1 Plastic Pipe Jointing

Flexible plastic pipe (PVC) gasketed joints shall conform to ASTM D 3212.

2.3.1.1 ABS Pipe Jointing

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 12 inches or less in diameter, dimensions and tolerances in accordance with Table 2 of ASTM D 2751.

2.3.2 Ductile Iron Pipe Jointing

Push-on joints shall conform to AWWA C111. Mechanical joints shall conform to AWWA C111 as modified by AWWA C151. Flanged joints shall conform to AWWA C115.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers should be cast iron. Frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. The word "Sewer" shall be cast into covers so that it is plainly visible.

2.6 STEPS

Steps shall be in accordance with City of Chesapeake Standard ST-1.

2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type V for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking. Air-entraining admixture conforming to ASTM C 260 shall be used with Type V cement. Where aggregates are alkali reactive, as determined by Appendix XI of ASTM C 33, a cement containing less than 0.60 percent alkalies shall be used.

2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.8 STRUCTURES

2.8.1 Precast Reinforced Concrete Manhole Sections and Gaskets

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

2.8.2 Interior Coating

Interior coating shall be per City of Chesapeake PFM.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 18 inches above the top of the sewer pipe, the horizontal spacing may be a minimum of 6 feet. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 10 feet on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 3 feet to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 4 inches.

3.1.1.2 Structural Foundations

Where sewer pipe is to be installed within 3 feet of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.

b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.

c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.

d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.

e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.2 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.3 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.4 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.5 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6.

Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 4 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 4 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 3-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 25 gal per inch diameter per mile of pipeline per day. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government. Pressure drop allowance shall be in accordance with the City of Chesapeake PFM Technical Specifications.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe, but 95 percent for RPMP and RTRP. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of 70,000 psi or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, or 5 percent for RTRP and RPMP, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLE DETAILS

3.4.1 General Requirements

Manholes shall be constructed of precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot. Free drop inside the manholes shall not exceed 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 1 foot 6 inches.

3.4.2 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.4.3 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 2 inches higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.4 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 2 inch adjusting rings. The bottom section shall be12 inches in height. A 6 inch high top section will cover up to two, 2 inchadjusting rings. A 12 inch high bottom section will cover up to six, 2 inch adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 2 inches and shall be overlapped by the top section by 2 inches.

3.5 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 5 feet outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 5 feet from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

-- End of Section --

SECTION 02532

FORCE MAINS
07/98

PART 1 GENERAL

1.1 REFERENCES

This specification supplements both the City of Chesapeake Public Facilities Manual PFM and the Hampton Roads Sanitation District (HRSD) standards, which are referred to below as the Owner's Standards. In the event of a conflict, the Owner's Standards shall govern.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM F 477	(1996a) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C111	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C900	(1989; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

CITY OF CHESAPEAKE

PFM	Public Facilities Manual Volume 1-111

DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

DIPRA-Restraint Design	(1997) Thrust Restraint Design for Ductile Iron Pipe

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Plastic Pipe; GA.

Ductile Iron Pipe; GA.

Warning Tape; GA.

Gate Valves; GA.

Air Release Valves; GA.

Valve Boxes; GA.

Pipe Coatings and Linings; GA.

Joints; GA.

Fittings; GA.

SD-06 Instructions

Instructions; GA.

The installation submittal shall include a detailed: pipe lay schedule, sequence of construction, and product shop drawings.

SD-09 Reports

Hydrostatic Tests; GA.

Copies of test results

1.3 DELIVERY AND STORAGE

Pipe, fittings and accessories, and pipe coatings shall not be damaged during delivery, handling, and storage.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Piping for force mains less than 4 inches in diameter shall be polyvinyl chloride (PVC) plastic. Piping for force mains 4 inches in diameter and larger shall be ductile iron. Pipe shall conform to HRSD requirements and to the City of Chesapeake PFM, the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PVC Pipe

a. PVC Pipe and Fittings Less Than 4 inches Diameter: AWWA C900.

2.1.2 Ductile Iron Pipe

a. Ductile Iron Pipe: AWWA C151, working pressure not less than 350 psi, unless otherwise shown or specified.

b. Fittings, Mechanical: AWWA C110, rated for 350 psi.

2.1.3 Warning Tape

Install a subsurface utility warning tape at a depth of 6 to 12 inches below the finished grade for all non-ferrous sewer mains. The utility warning tape shall be manufactured by Griffolyn Co., or approved equal. The tape shall be made of a durable, metalized, plastic film similar to Terra Tape D for identification of sewer mains; bright green tape imprinted with the legend "Caution - Sewer Below" shall be used.

2.2 JOINTS

2.2.1 PVC Piping

a. Push-On Joint Fittings: ASTM D 3139, with ASTM F 477 gaskets.

b. Couplings for use with plain end pipe shall have centering rings or stops to ensure the coupling is centered on the joint.

2.2.2 Ductile Iron Piping (Restrained Joint)

a. Mechanical Joints: AWWA C111 as modified by AWWA C151.

2.3 VALVES

2.3.1 Gate Valves

Gate Valves shall conform to the requirements of HRSD and the PFM.

2.3.2 Air Release Valves

Air Release Valves shall conform to requirements of HRSD and the PFM.

2.4 VALVE BOXES

Valve Boxes shall be City Standard VB-1, of PFM Vol. II. Valve boxes and lids shall be manufactured from cast iron meeting ASTM A 48 Class 30. Casting shall be dipped in an asphaltic coating.

2.5 MISCELLANEOUS MATERIALS

Miscellaneous materials shall comply with the following requirements:

2.5.1 Pipe Coatings and Linings

Pipe coatings and linings shall conform to requirements of HRSD and City of Chesapeake PFM.

2.5.2 Joint Lubricants

Joint lubricants shall be as recommended by the pipe manufacturer.

2.5.3 Bolts, Nuts and Glands

AWWA C111.

2.5.4 Joint Compound

A stiff mixture of graphite and oil or inert filler and oil.

2.5.5 Joint Tape

ASTM D 3308.

2.5.6 Bond Wire

Bond wire type RHW or USE, Size 1/0 AWG, neoprene jacketed copper conductor shaped to stand clear of the joint.

PART 3 EXECUTION

3.1 INSTALLATION

Pipe, pipe fittings, and appurtenances shall be installed at the locations indicated. Excavation, trenching, and backfilling shall be as specified in Section 02222 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS. Force main installation shall comply with PFM and HRSD requirements.

3.1.1 Adjacent Facilities

Installation of force mains near adjacent facilities shall be as specified in Section 02531 SANITARY SEWERS.

3.1.2 Cutting

Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practicable. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying. Any coatings or lining damaged during the cutting operation shall be repaired prior to installation.

3.1.3 Laying

Except where otherwise authorized, pipe shall be laid with bells facing the direction of laying. Before lowering and while suspended, the pipe shall be inspected for defects. Defective material shall be rejected. Pipe shall be laid in compliance with the following:

a. Ductile Iron: AWWA C600.

b. Polyvinyl Chloride: Manufacturer's instructions.

3.1.4 Jointing

3.1.4.1 Joints for PVC Pipe

a. Push-on joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. The gasket shall remain in proper position in the bell or coupling while the joint is made.

3.1.4.2 Joints for Ductile Iron Pipe

Installation of mechanical and push-on type joints shall comply with AWWA C600 and the manufacturer's instructions. Installation of flanged joints shall comply with manufacturer's instructions.

3.1.5 Installation of Valves

Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and closed to ensure that all parts are properly operating. Valves shall be installed with the stem in the vertical position. Valves shall be installed in valve vaults as indicated.

3.1.6 Installation of Valve Boxes

Valve boxes shall be installed over each outside gate valve, unless otherwise indicated. Valve boxes shall be centered over the valve. Fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.

3.1.7 Thrust Restraint

Thrust Restraint shall be as specified by HRSD. See Contract Drawings for information.

3.1.7.1 Restrained Joints

For ductile iron pipe, restrained joints shall be designed by the Contractor or the pipe manufacturer in accordance with DIPRA-Restraint Design and in accordance to the requirements of HRSD. See Contract Drawings.

3.1.8 Grout

Grout for exterior joint protection on concrete pipes shall be a mix of 1 part portland cement, 2 parts sand, and of sufficient liquid consistency to flow into the joint recess beneath the diaper. Grout for interior joint protection shall be a mix of 1 part portland cement and 1 part sand. A polyurethane foam loop, impregnated with portland cement, may be substituted for grout for exterior joints.

3.1.9 Bonded Joints

Where indicated, a metallic bond shall be provided at each joint, including joints made with flexible couplings or rubber gaskets, of ferrous-metallic piping to effect continuous conductivity. The bond shall be of the thermal-weld type.

3.2 HYDROSTATIC TESTS

The pipeline shall be subjected to both a pressure test and a leakage test. The method proposed for disposal of waste water from hydrostatic tests shall be approved by the Contracting Officer. Testing shall be the responsibility of the Contractor. The Contractor shall be responsible for supplying all calibrated gauges, water, and other equipment necessary for all testing procedures. All testing precedures shall be in accordance with the City of Chesapeake PFM technical specifications and HRSD specifications. Testing shall be performed by an approved independent testing laboratory or by the Contractor subject to approval. The test may be witnessed by the Contracting Officer. The Contracting Officer shall be notified at least 7 days in advance of equipment tests. The final test report shall be delivered to the Contracting Officer within 30 days of the test.

3.2.1 Pressure Test

After the pipe has been installed, joints completed, thrust blocks have been in place for at least five days, and the trench has been partially backfilled, leaving the joints exposed for examination, the pipe shall be filled with water to expel all air. The pipeline shall be subjected to a test pressure of 125 psi or 150 percent of the working pressure, whichever is greater, for a period of at least 2 hours. Each valve shall be opened and closed several times during the test. The exposed pipe, joints, fitting, and valves shall be examined for leaks. Visible leaks shall be stopped or the defective pipe, fitting, joints, or valve shall be replaced. Acceptance of the pressure testing shall be in accordance with the City of Chesapeake PFM and HRSD.

3.2.2 Leakage Test

The leakage test may be conducted subsequent to or concurrently with the pressure test. The amount of water permitted as leakage for the line shall be placed in a sealed container attached to the supply side of the test pump. No other source of supply will be permitted to be applied to the pump or line under test. The water shall be pumped into the line by the test pump as required to maintain the specified test pressure as described for pressure test for a 2 hour period. Exhaustion of the supply or the inability to maintain the required pressure will be considered test failure. PE pipe can experience diametric expansion and pressure elongation during initial testing. The manufacturer shall be consulted prior to testing for special testing considerations. Allowable leakage shall be determined by the Owner's Standards.

At the conclusion of the test, the amount of water remaining in the container shall be measured and the results recorded in the test report.

3.2.3 Retesting

If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted until the results of the tests are within specified allowances, without additional cost to the Government.

-- End of Section --

SECTION 02630

STORM-DRAINAGE SYSTEM
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT S	(2001) Road and Bridge Standards
VDOT RBS	(1994 January) Road and Bridge Specifications

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Instructions

Placing Pipe; FIO.

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-13 Certificates

Industrial Cut Sheets; FIO. Pipeline Testing; GA. Hydrostatic Test on Watertight Joints; GA. Determination of Density; FIO. Frame and Cover for Gratings; GA.

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

SD-14 Samples

Pipe for Culverts and Storm Drains; GA;.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified in VDOT RBS Section 232.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design as specified in the VDOT RBS Section 232.

2.2.2 Precast Reinforced Concrete Structures

Precast drainage structures shall be of a standard design as specified in the VDOT RBS Section 302.

2.2.3 Erosion Control Stone

Erosion control stone shall conform to VDOT RBS, Section 204.02.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Concrete and reinforced concrete shall conform to the requirements specified in the VDOT RBS Section 217.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to the VDOT RBS Section 218.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to the VDOT RBS Section 222.

2.3.4 Brick

Brick shall conform to the VDOT RBS Section 222.

2.3.5 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall be of a standard design as specified in the VDOT S and VDOT RBS

2.3.6 Frame and Cover for Gratings

Frame and cover for gratings shall conform to the VDOT RBS, Section 224.

2.3.7 Joints

Joint material and gaskets shall conform to the requirements of the VDOT RBS, Section 212.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall conform to the VDOT S and VDOT RBS, Section 203.02. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall conform to the requirements of the VDOT S.

3.3 PLACING PIPE

Placing pipe shall conform to the requirements of the VDOT RBS Section 302.03. Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.4 JOINING

Joining of pipe shall conform to the requirements of the VDOT RBS Section 302.03.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete or precast concrete segmental blocks; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

Backfilling shall conform to the requirements of the VDOT RBS Section 302.03.

-- End of Section --

SECTION 02763

PAVEMENT MARKINGS
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(1994) Road and Bridge Specifications.
VWAPMSG	(1996) Virginia Work Area Protection Manual, Standards and Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Lists; GA.

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

SD-06 Instructions

Mixing, Thinning and Application; FIO.

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

SD-08 Statements

Qualifications; FIO.

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-09 Reports

Material Tests; GA.

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-13 Certificates

Volatile Organic Compound (VOC) Content; FIO.

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.3 TERMINOLOGY

All references in VDOT RBS to "Engineer" or "Department" shall mean Contracting Officer (CO) or his authorized representative.

1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment shall display low speed traffic markings and traffic warning lights.

1.6 TRAFFIC CONTROLS

Traffic control shall be performed in accordance with the manual or uniform traffic control devices and the VWAPMSG. Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

PART 2 PRODUCTS

2.1 PAVEMENT MARKINGS

a. Type A shall conform to VDOT RBS Specification Section 231.

b. Type B shall conform to VDOT RBS Specification Section 246.

c. Glass beads shall conform to VDOT RBS Specification Section 234.

2.2 RAISED RETRO REFLECTIVE MARKERS

Retro reflective markers shall conform to VDOT RBS Specification Section 235.

PART 3 PROCEDURES

Procedures shall conform to VDOT RBS Specification Section 704.03.

-- End of Section --

SECTION 02770

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(1996) Making and Curing Concrete Test Specimens in the Field
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 171	(1997) Sheet Materials for Curing Concrete
ASTM C 172	(1997) Sampling Freshly Mixed Concrete
ASTM C 173	(1996) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1997) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 920	(1995) Elastomeric Joint Sealants
ASTM D 3405	(1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

VIRGINIA DEPARTMENT OF TRANSPORTATION (VDOT)

VDOT RBS	(1994) January, Road and Bridge Specifications, and all supplements thereto.

CITY OF CHESAPEAKE

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

Field Quality Control; FIO.

Copies of all test reports within 24 hours of completion of the test.

SD-18 Records

Concrete; GA.

Copies of certified delivery tickets for all concrete used in the construction.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches. Concrete shall be Class A-3 air entrained concrete as per VDOT RBS Section 217 and in accordance with AASHTO M 85 and AASHTO M 154 for air entraining concrete admixtures.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 2 inches plus or minus 1 inch where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcing steel shall be Grade 40 or 60 and conform to VDOT RBS Section 223.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 Curing Material

Curing material shall consist of waterproof paper, polyethylene sheeting, liquid membrane seal or water in accordance with VDOT RBS Section 220.02.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler

Expansion joint filler, shall conform to VDOT RBS Section 212.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to ASTM C 920.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

Curb, curb & gutter, and sidewalks must be constructed in accordance with the applicable VDOT RBS standards, the standards of the City of Chesapeake's Public Facilities Manual (PFM) and in accordance with the construction plans.

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 02225.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

a. The Contractor will prepare a sample panel of the broom finish for approval by the Contracting Officer that will establish the criteria upon which all sidewalk finishes will match.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall conform to the City of Chesapeake PFM.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall conform to the City of Chesapeake PFM.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 3/8 inch in width shall be provided at intervals not exceeding 50 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches.The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector.

If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 02935
TURF

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS-01	(Amended thru: Aug 1988) Federal Seed Act Regulations (Part 201-202)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2607	(1969) Peats, Mosses, Humus, and Related Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	(Basic; Notice 1) Fertilizer

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's Literature; FIO.

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material, and for chemical treatment material.

SD-07 Schedules

Equipment List; FIO.

A list of proposed pesticide application, seeding and mulching equipment to be used in performance of turfing operation, including descriptive data and calibration tests.

SD-08 Statements

Delivery; GA.

Delivery schedule, at least 10 days prior to the intended date of the first delivery.

Application of Pesticide; GA.

Pesticide treatment plan with proposed sequence of pesticide treatment work. The pesticide trade name, chemical composition, formulation, concentration, application rate of active ingredients and method of application for all materials; and the name and state license number of the state certified applicator shall be included.

Maintenance Report; FIO.

Written record of maintenance work performed.

Turf Establishment Period; FIO.

Written calendar time period for the turf establishment period. When there is more than one turf establishment period, the boundaries of the turfed area covered for each period shall be described.

SD-13 Certificates

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Certified copies of the reports for the following materials shall be included:

Seed; GA.

For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, date tested and state certification.

Fertilizer; GA.

For chemical analysis, composition percent.

Agricultural Limestone; GA.

For calcium carbonate equivalent and sieve analysis.

Peat; GA.

For compliance with ASTM D 2607.

Pesticide Material; GA.

For EPA registration number and registered uses.

Topsoil; GA.

For pH, particle size, chemical analysis and mechanical analysis.

1.3 SOURCE INSPECTIONS

Sod material will be subject to inspection by the Contracting Officer at the growing site.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

1.4.1.1 Topsoil

A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.3 Pesticide

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site by the Contracting Officer for conformity to type and quality in accordance with paragraph MATERIALS. Other materials shall be inspected for meeting specified requirements and unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in areas designated by the Contracting Officer. Seed, lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment materials shall not be stored with other landscape materials.

1.4.4 Handling

1.4.4.1 Materials

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Seed

2.1.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws.

2.1.1.2 Seed Mixtures

Seed mixtures shall be as indicated on the contract drawings.

2.1.1.3 Quality

Weed seed shall not exceed 1 percent by weight of the total mixture. Wet, moldy, or otherwise damaged seed shall be rejected.

2.1.1.3 Temporary Seed

The temporary seed for erosion control shall be as indicated on the contract drawings.

2.1.1.4 Seed Mixing

The field mixing of seed shall be performed on site in the presence of the Contracting Officer.

2.1.2 Topsoil

2.1.2.1 Topsoil Materials

Topsoil shall be natural, friable, loam topsoil possessing the characteristics of representative soils in the vicinity that produce heavy growths of crops, grass, or other vegetation, and shall be obtained from naturally well drained areas. The topsoil shall be free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and shall be free from stones, stumps, and other objects larger than one-half inch in diameter, from roots and toxic substances, and from any other material or substance that might be harmful to plant growth or to be a hindrance to grading, planting, and maintenance operations.

2.1.3.2 Existing Topsoil

Existing topsoil on the project site, providing it meets the aforementioned characteristics, shall be stripped to the depth indicated and stockpiled on the site in accordance with Section 02210 GRADING, and amended by the addition of lime as a pH adjuster at the rate necessary to bring the soil pH within a range of 6.2 to 7.0.

2.1.3.3 Additional Topsoil

Additional topsoil, if required beyond that available from stripping operations, shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from well-drained borrow areas, provided by the Contractor, and shall be free of any admixture of subsoil, foreign matter, objects larger than one inch in any dimension, toxic substances, and any material or substance that may be harmful to plant growth. The pH range shall be 6.2 to 7.0. Topsoil that does not meet this pH range shall be amended by the addition of pH adjusters, at a rate recommended based on soil tests. Organic content shall be 3 to 5 percent.

2.1.3 Soil Amendments

Soil amendments shall consist of lime, fertilizer, organic soil amendments and soil conditioners meeting the following requirements.

2.1.3.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

2.1.3.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909. Granular Fertilizer: As recommended by the soil test.

2.1.4.3 Organic Soil Amendments

a. Peat: Hypnum moss peat or Peat humus derived from a bog, swampland or marsh shall conform to ASTM D 2607.

b. Sand: Clean, free of toxic materials; 95 percent by weight shall pass a No. 10 sieve and 10 percent by weight shall pass a No. 16 sieve.

c. Decomposed Wood Derivatives: Ground bark, sawdust, or other wood waste material free of stones, sticks, soil, and toxic substances harmful to plants, stabilized with nitrogen and having the following properties:

Particle Size: Minimum percent by weight passing:

Sieve Size	Percent
No. 4	95
No. 4	80

Nitrogent Content: Minimum percent based on dry weight:

Material	Percent
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.1.5 Mulch

Mulch shall be free from weeds, mold, and other deleterious materials.

2.1.4 Straw

Straw shall be stalks from oats, wheat, rye, barley, or rice furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

2.1.5 Hay

Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings furnished in an air-dry condition suitable for placing with commercial mulch-blowing equipment.

2.1.6 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate visual metering during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.1.7 Wood Chips

Wood chips shall be chips or shredded bark with maximum particle size of 3/16 inch.

2.1.5.5 Paper Fiber Mulch

Paper fiber mulch shall be recycled news print that is shredded for the purpose of mulching seed.

2.1.8 Water

Water shall not contain elements toxic to plant life.

2.1.9 Pesticide

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide and miticide. For the purpose of this specification, soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved insecticide, herbicide, fungicide, nematocide, rodenticide, miticide, and soil fumigant.

2.1.10 Erosion Control Material

Soil erosion control shall conform to the following:

2.1.10.1 Soil Erosion Control Blanket

Machine produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either knitted straw blanket-like mat construction, covered with biodegradable plastic mesh, or interwoven biodegradable thread, plastic netting or twisted kraft paper cord netting.

2.1.10.2 Soil Erosion Control Fabric

Knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

2.1.10.3 Soil Erosion Control Net

Heavy, twisted jute mesh weighing approximately1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.1.10.4 Soil Erosion Control Chemicals

High-polymer synthetic resin or cold-water emulsion of selected petroleum resins.

2.1.10.5 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life, without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids must resist mold growth.

2.1.10.6 Anchors

Erosion control anchor material shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 SEEDING TIMES AND CONDITIONS

3.1.1 Seeding Time

Seed shall be sown from 1 Mar to 1 May for spring planting and from 1 Sep to 15 Oct for fall planting.

3.1.2 Turfing Conditions

Turf operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed.

When special conditions warrant a variance to the turf operations, proposed times shall be submitted to and approved by the Contracting Officer.

3.1.3 Areas To be Treated

Areas to be treated shall include the following:

a. All ground areas disturbed during the course of construction and within the limits of the contract shall be topsoiled, tilled, limed, fertilized, seeded, and mulched.

b. Areas to be seeded are indicated on the drawings.

3.2 SITE PREPARATION

3.2.1 Grading

The Contracting Officer shall verify that finished grades are as indicated on drawings, and the placing of topsoil and the smooth grading has been completed in accordance with Section 02210 GRADING.

3.2.2 Application of Soil Amendments

3.2.2.1 Soil Test

A soil test shall be performed for pH, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of turf specified.

3.2.2.2 Lime

Lime shall be applied at the rate recommended by the soil test. Lime shall be incorporated into the soil to a minimum depth of 4 inches or may be incorporated as part of the tillage operation.

3.2.2.3 Fertilizer

Fertilizer shall be applied at the rate recommended by the soil test. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches and may be incorporated as part of the tillage or hydroseeding operation.

3.2.3 Tillage

3.2.3.1 Minimum Depth

Soil on slopes gentler than 3-horizontal-to-1-vertical shall be tilled to a minimum depth of 4 inches. On slopes between 3-horizontal-to-1-vertical and 1-horizontal-to-1 vertical, the soil shall be tilled to a minimum depth of 2 inches by scarifying with heavy rakes, or other method. Rototillers shall be used where soil conditions and length of slope permit. On slopes 1-horizontal-to-1 vertical and steeper, no tillage is required.

3.2.4 Finished Grading

3.2.4.1 Placing Topsoil

Topsoil shall be distributed uniformly and spread evenly to an average thickness of three inches, with a minimum thickness of two inches. Topsoil shall be spread so that planting can proceed with little additional soil preparation or additional tillage. Surface irregularities resulting from topsoiling or other operations shall be leveled to prevent depressions. Grade shall be adjusted to assure that planted grade will be one inch below adjoining grade of any surfaced area. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, excessively compacted, or in a condition detrimental to the proposed planting or grading. Soil compacted by construction equipment or soil on compacted cut slopes of grades shall be pulverized to a minimum depth of two inches by disking or plowing before applying topsoil.

3.2.4.2 Preparation

Turf areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on drawings. Turf areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of erosion or grade deficiencies shall conform to topsoil requirements specified in Section 02210 GRADING. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas.

3.2.4.3 Field Area Debris

Field areas shall have debris and stones larger than 3 inches in any dimension removed from the surface.

3.2.4.4 Protection

Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

3.3 SEEDING

3.3.1 General

Prior to seeding, any previously prepared seedbed areas compacted or damaged by interim rain, traffic or other cause, shall be reworked to restore the ground condition previously specified. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.2 Equipment Calibration

The equipment to be used and the methods of turfing shall be subject to the inspection and approval of the Contracting Officer prior to commencement of turfing operations. Immediately prior to the commencement of turfing operations, the Contractor shall conduct turfing equipment calibration tests in the presence of the Contracting Officer.

3.3.3 Applying Seed

3.3.3.1 Broadcast Seeding

Seed shall be uniformly broadcast at the rate of 4 pounds per 1000 square feet using broadcast seeders. Half of seed shall be broadcast in one direction, and the remainder at right angles to the first direction. Seed shall be covered to an average depth of 1/4 inch by disk harrow, steel mat drag, cultipacker, or other approved device.

3.3.3.2 Rolling

Immediately after seeding, except for slopes 3-horizontal-to-1 vertical and greater, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with seed drills equipped with rollers shall not be rolled.

3.3.4 Hydroseeding

Seed and fertilizer shall be added to water and thoroughly mixed at the rates specified. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed, fertilizer and water have been thoroughly mixed, to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.5 Mulch

3.3.5.1 Straw or Hay Mulch

Straw or hay mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of a steep slope and continued uniformly until the area is covered. The mulch shall not be bunched. All seeded areas shall be mulched on the same day as the seeding.

3.3.5.2 Mechanically Anchoring

Immediately following spreading, the mulch shall be anchored to the soil by a V-type-wheel land packer, a scalloped-disk land packer designed to force mulch into the soil surface, or other suitable equipment.

3.3.5.3 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at rate recommended by manufacturer. Apply with hydraulic equipment suitable for mixing and applying uniform mixture of tackifier.

3.3.5.4 Wood Cellulose Fiber

Wood cellulose fiber mulch for use with the hydraulic application of seed and fertilizer shall be applied as part of the hydroseeding operation.

3.3.6 Water

Watering shall be started within 7 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 1 inch. Run-off and puddling shall be prevented.

3.4 EROSION CONTROL

3.4.1 Erosion Control Material

Erosion control material, where indicated or required, shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.4.2 Temporary Turf Cover

3.4.2.1 General

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed as directed by the Contracting Officer.

3.4.2.2 Application

When no other turfing materials have been applied, the quantity of one half of the required soil amendments shall be applied and the area tilled in accordance with paragraph SITE PREPARATION. Seed shall be uniformly broadcast and applied at the rate of 2.5 pounds per 1000 square feet. The area shall be watered as required.

3.5 APPLICATION OF PESTICIDE

When pesticide becomes necessary to remove a pest or disease, a state-certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges. A pesticide plan shall be provided to the Contracting Officer as stated in paragraph SUBMITTALS.

3.6 RESTORATION AND CLEAN UP

3.6.1 Restoration

Existing turf areas, pavements and facilities that have been damaged from the turfing operation shall be restored to original condition at Contractor's expense.

3.6.2 Clean Up

Excess and waste material shall be removed from the planting operation and shall be disposed of off the site. Adjacent paved areas shall be cleaned.

3.7 PROTECTION OF TURFED AREAS

Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by the Contracting Officer.

3.8 TURF ESTABLISHMENT PERIOD

3.8.1 Commencement

The Turf Establishment Period for establishing a healthy stand of turf shall begin on the first day of work under this contract and shall end three (3) months after the last day of turfing operations required by this contract. Written calendar time period shall be furnished to the Contracting Officer for the Turf Establishment Period. When there is more than one turf establishment period, describe the boundaries of the turfed area covered for each period.

3.8.2 Satisfactory Stand of Turf

3.8.2.1 Seeded Area

a. Field Area: A satisfactory stand of turf from the seeding operation for a field area is defined as a minimum of 10 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

3.8.3 Maintenance During Establishment Period

3.8.3.1 General

Maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turfed areas from traffic, mowing, watering, and post-fertilization.

3.8.3.2 Mowing

a. Field Areas: Field areas shall be mowed once during the season to a minimum height of 3-1/2 inches.

3.8.3.3 Watering

Watering shall be at intervals to obtain a moist soil condition to a minimum depth of 1 inch. Frequency of watering and quantity of water shall be adjusted in accordance with the growth of the turf. Run-off, puddling and wilting shall be prevented.

3.8.3.4 Post-Fertilization

Nitrogen carrier fertilizer shall be applied at the rate of 0.5 pounds per 1000 square feet after the first month and again in 3 months. The application shall be timed prior to the advent of winter dormancy and shall avoid excessively high nitrogen levels.

3.8.3.5 Pesticide

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.8.3.6 Repair

The Contractor shall re-establish as specified herein, eroded, damaged or barren areas. Mulch shall also be repaired or replaced as required.

3.8.3.7 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed.

3.9 FINAL ACCEPTANCE

3.9.1 Preliminary Inspection

Prior to the completion of the Turf Establishment Period, a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be established in writing. The acceptability of the turf in accordance with the Turf Establishment Period shall be determined. An unacceptable stand of turf shall be repaired as soon as turfing conditions permit.

3.9.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing.

-- End of Section --

SECTION 02936

ESTABLISHMENT OF MARSHGRASS
05/00

PART 1 GENERAL

1.1 APPLICABLE PUBLICATIONS

The following publications of the issues listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent issue of the publication in effect on the date of award shall govern the work.

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-1909	Fertilizer

UNITED STATES DEPARTMENT OF AGRICULTURE

Natural Resources Conservation Service	National Plant Database

1.2 SUBMITTALS

The Contractor shall make submittals for the following listed reports and certificates as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) representative and each item shall be stamped, signed, and dated by the CQC representative indicating action taken in accordance with SECTION 01451.

1.2.1 Certificates of Compliance

Statement signed by an official authorized to certify on behalf of the manufacturer or supplier of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of the contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements which are being certified in accordance with the contract specification. Certified copies of the reports for the following materials shall be included in these certificates:

a. Marsh Grass Sprigs

For types, quality of formed transplants, healthy and free from visual disease, free of harmful insects, healthy and relatively unbroken root systems, date tested and state certification.

b. Fertilizer

For chemical analysis, composition percent.

1.2.2 Manufacturer's Literature

Manufacturer's literature discussing physical characteristics, application and installation instructions for erosion control material and for chemical treatment material. Literature shall include a list of proposed pesticide application, equipment to be used in performance of planting operations, including descriptive data and calibration tests.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Soil amendments shall be delivered to the site in original, unopened containers bearing the manufacturer's guaranteed chemical analysis, and name. In lieu of containers, soil conditioners, and amendments may be furnished in bulk, and a certificate from the manufacturers indicating the above information shall accompany each delivery.

1.3.2 Storage

1.3.2.1 Sprigs

Sprigs shall be sprinkled with water and covered with moist burlap, straw, or other approved covering and protected from exposure to wind and direct sunlight. Covering shall be such that air can circulate and heating will not develop.

1.3.2.2 Soil Amendments

Soil amendments shall be kept in dry storage away from contaminants, insects, and rodents.

1.3.3 Handling

Care shall be taken to avoid drying or damaging plants being moved from the storage area to the planting site.

PART 2 PRODUCTS

2.1 MARSH GRASSES

Planting stock to be provided under this contract shall be nursery grown sprigs of three species identified in the National Plant Database as spartina alterniflora (smooth cordgrass), spartina patens (saltmarsh hay), and scirpus pungens (common threesquare). Nursery grown stock shall be 3 month plants or larger in peat pots that are 1-3/4 inches or larger. Planting stock shall be well formed transplants, sound, vigorous, healthy, and free from disease, sunscald, harmful insects, and shall have healthy, normal and relatively unbroken root systems.

2.2 FERTILIZER

Fertilizer shall be commercial grade and uniform in composition.

2.2.1 Granular Fertilizer

Granular fertilizer shall conform to CID A-A-1909 and shall bear the manufacturer's guaranteed statement of analysis. Granular fertilizer to be used on this project shall be as follows:

a. Spring or summer planting of Marsh Grasses - fertilizer shall be a 3-4 month slow release form containing a 19N-6P-12K ratio.

b. Fall or winter planting of Marsh Grasses - fertilizer shall be a 8-9 month slow release form containing a 18N-6P-12K ratio.

2.3 TOPSOIL

Topsoil shall be provided as specified in SECTION 02210 and SECTION 02935 as applicable.

PART 3 EXECUTION

3.1 PLANTING OF MARSH GRASSES

3.1.1 Areas to be Planted

Tidal and non-tidal zones scheduled to be sprigged with marsh grasses are shown on the plan. Limits of planting shall be defined and marked on the site and approved by the Contracting Officer prior to planting operations.

3.1.2 Planting Dates

Preferable planting dates for the establishment of marsh grasses are between 1 March and 1 September; however, fall or winter planting is acceptable if the ground is not frozen, snow-covered, or in an otherwise unsatisfactory condition for planting.

3.1.3 Planting Execution

Holes shall be excavated at least 3 inches wide, and 5 to 6 inches deep, and at 2-foot intervals in staggered rows. Tidal zone plantings shall be 75% spartina alterniflora and 25% scirpus pungens planted randomly, and 100% spartina patens shall be planted in designated areas above mean high tide. Holes may be dug by hand or auger. Marsh grass sprigs shall be watered prior to placement, and subsequently, the sprigs shall be placed in the planting holes to a depth of 5 to 6 inches. The remaining excavated area in the holes shall be backfilled with soil removed during hole excavation.

3.1.4 Fertilization

Simultaneous with the planting operation of marsh grasses, each plant shall be fertilized as follows:

3.1.4.1 Spring and Summer Planting

Fertilize each plant with 30 grams of 3-4 months slow release fertilizer (19N-6P-12K).

3.1.4.2 Fall and Winter Planting

Fertilize each plant with 30 grams of 8-9 months slow release fertilizer (18N-6P-12K).

3.1.5 Plant Establishment Period for Marsh Grasses

The establishment period will be in effect for 12 months. All plants that die during the establishment period shall be replaced. No additional plant establishment period will be required for replacement plants.

3.1.6 Final Acceptance

Final inspection and acceptance will be at the end of the Marsh Grass establishment period. Acceptance will be based upon a satisfactory stand of marsh grass and there is evidence that all plants are alive and in a healthy condition.

-- End of Section --

SECTION 02950
TREES, SHRUBS, GROUND COVERS, AND VINES

03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF NURSERYMEN (AAN)

AAN-01	(1990) American Standard for Nursery Stock

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2607	(1969) Peats, Mosses, Humus, and Related Products

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	(Basic; Notice 1) Fertilizer

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Erosion Control Material; GA.

Manufacturer's literature discussing physical characteristics, application and installation instructions for edging material and erosion control material.

SD-07 Schedules

Equipment List; FIO.

A list of the proposed pesticide application equipment to be used in performance of the planting work, including descriptive data and calibration tests.

SD-08 Statements

Delivery; FIO. Application of Pesticide Material; GA.

The following work plans, before work is started.

a. Delivery Schedule at least 10 days prior to the intended date of the first delivery.

b. Pesticide Treatment Plan, giving proposed sequence of pesticide treatment work, before work is started. The pesticide trade name, chemical composition, formulation, concentration, application rate of active ingredients and methods of application for all materials furnished, and the name and state license number of the state certified applicator shall be included.

SD-09 Reports

Soil Test; GA. Percolation Test; GA.

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-13 Certificates

Topsoil; FIO. Soil Amendments; FIO. Plants; FIO.
Pesticide; FIO.

Certificates of compliance certifying that materials meet the requirements specified, prior to the delivery of materials. Reports for the following materials shall be included.

a. Topsoil: For pH, chemical analysis, mechanical analysis and particle size.

b. Fertilizer: For chemical analysis and composition percent.

c. Agricultural Limestone: For sieve analysis and calcium carbonate equivalent.

d. Peat: For compliance with ASTM D 2607.

e. Plant Materials: For botanical and common name, size, quantity by species, grade, nursery grown.

f. Pesticide Material: For EPA registration number and registered uses.

SD-18 Records

Plant Establishment Period; GA. Maintenance Report; FIO.
Maintenance Instructions; FIO.

a. Maintenance Report. Written record of maintenance work performed and quantity of plant losses and replacements.

b. Plant Establishment Period. Written calendar time period for the beginning of the plant establishment period. When there is more than one establishment period, the boundaries of the planted areas covered for each period shall be described.

c. Maintenance Instruction. Written instructions for year-round care of installed plants.

1.3 SOURCE INSPECTIONS

1.3.1 Plant Materials

Plant materials shall be subject to inspection at the growing site by the Contracting Officer.

1.3.2 Delivered Topsoil

The source of topsoil shall be subject to inspection by the Contracting Officer.

1.4 SHIPMENT, DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Shipment

1.4.1.1 Preparation

Digging and preparation for shipment shall be done in a manner that will not cause shock or damage to branches, trunk, or root systems.

a. Balled and Burlapped (BB) Plants: Ball size and ratio shall be provided as recommended by AAN-01. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. Removal shall be accomplished by hand digging or mechanical devices. Center the plant stem or trunk in the ball and clean cut all roots at the ball surface. No roots shall be pulled from the ground. The root ball shall be completely wrapped with burlap or other suitable material and securely laced with twine.

b. Balled and Potted (Pot) Plants: Ball size and ratio shall be provided as recommended by AAN-01. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. Removal shall be accomplished by hand digging or mechanical devices. The plant stem or trunk shall be centered in the ball and all roots shall be clean cut at the ball surface. No roots shall be pulled from the ground. Containers shall be used to retain the ball unbroken. Container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

c. Balled and Platform (BP) Plants: Ball size and ratio shall be provided as recommended by AAN-01. Plants shall be prepared as BB plants and securely fastened to wood platform for shipping.

d. Bare-Root (BR) Plants: Minimum root spread shall be as recommended by AAN-01. A well branched root system characteristic of the variety specified shall be provided. No roots shall be pulled from the ground. The root system shall be protected from drying out.

e. Container-Grown (C) Plants: Container size shall be provided as recommended by AAN-01. Plants shall be grown in a container sufficiently long for new fibrous roots to have developed and for root mass to retain its shape and hold together when removed from container. Container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

1.4.2 Delivery

1.4.2.1 Identification

Plants shall be identified with durable waterproof labels and weather-resistant ink. Plants shall have attached labels stating the correct plant name and size.

1.4.2.2 Protection During Delivery

Plants shall be protected during delivery to prevent desiccation of the plant or damage to the roots or balls. Branches of plants shall be protected by tying-in the branches and covering all exposed branches.

1.4.2.3 Topsoil

A soil test shall be provided for topsoil delivered to the site.

1.4.2.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.2.5 Pesticide

Pesticide materials shall be delivered to the site in the original unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration numbers and the registered uses.

1.4.3 Inspection

Plant material shall be inspected upon arrival at the jobsite by the Contracting Officer for conformity to the paragraph PLANTS and paragraph Shipment, and any unacceptable plant material shall be removed from the jobsite.

1.4.4 Storage

1.4.4.1 Plant Storage

Plants not installed on the day of arrival at the site shall be stored and protected in areas designated by the Contracting Officer. Plants shall be protected from exposure to wind and shall be shaded from the sun. Covering that will allow air to circulate and prevent internal heat from building up shall be provided. Bare-root plants shall be heeled-in. All plants shall be kept in a moist condition by watering with a fine mist spray until planted.

1.4.4.2 Storage of Other Materials

Soil amendments shall be stored in dry locations away from contaminants. Pesticide materials shall not be stored with other landscape materials. Storage of materials shall be in areas designated or as approved by the Contracting Officer.

1.4.5 Handling

Care shall be taken to avoid injury to plants. Materials shall not be dropped from vehicles. Balled and burlapped plants shall be handled carefully to avoid cracking or breaking the earth ball and container-grown plants shall be handled by the container. Plants shall not be handled by the trunk or stems.

1.4.5.1 Time Limitation

a. Mulch: Limitation of time between installing plant and placing mulch is 48 hours.

b. Trunk Wrap: Limitation of time between installing deciduous trees and wrapping the trunks is 24 hours.

c. Transplanting Existing Plants: Limitation of time between digging and replanting existing plant material is one hour.

1.5 WARRANTY

Furnished plants shall be guaranteed to be in a vigorous growing condition for a period of 12 months regardless of the contract time period. A plant shall be replaced one time under this guarantee. Transplanted existing plants require no guarantee. A written calendar time period for the guarantee of plant growth shall be furnished to the Contracting Officer.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Varieties

Plants shall be nursery grown or plantation grown stock conforming to AAN-01 and shall be of the varieties specified in the plant list bearing botanical names listed in one or more of the publications listed under "Nomenclature" in AAN-01.

2.1.2 Substitutions

Substitutions will not be permitted without written request from the Contractor for approval by the Contracting Officer.

2.1.3 Growing Conditions

Plants shall be grown under climatic conditions similar to those in the locality of the project.

2.1.4 Quality

Well shaped, well grown, vigorous, healthy plants having healthy and well branched root systems shall be provided. Plants shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plants shall be provided that are typical of the species or variety and conforming to standards as set forth in AAN-01 and as specified herein.

2.1.4.1 Shade and Flowering Trees

A height relationship to caliper shall be provided as recommended by AAN-01. Height of branching should bear a relationship to the size and variety of tree specified and with the crown in good balance with the trunk. Trees shall not be "poled" or the leader removed.

a. Single stem: Trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there should be no division of the trunk which branches more than six inches from ground level.

c. Specimen: A plant shall be provided that is well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

2.1.4.2 Deciduous Shrub

Plants shall be provided that have the height and number of primary stems as recommended by AAN-01. An acceptable plant shall be well shaped with sufficient well-spaced side branches recognized by the trade as typical for the variety grown in the region.

2.1.4.3 Coniferous Evergreen

Trees shall be provided that have the height-to-spread ratio as recommended by AAN-01. Trees shall not be "poled" or the leader removed. An acceptable plant shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.4.4 Broadleaf Evergreen

Plants shall be provided that have ratio of height-to-spread as recommended by AAN-01. An acceptable plant shall be well shaped and recognized by the trade as typical for the variety grown in the region.

2.1.5 Size

Plants shall be furnished in sizes indicated. Plants larger in size than specified may be provided at no additional cost to the Government.

2.1.6 Measurement

Plant measurements shall be in accordance with AAN-01.

2.2 TOPSOIL

Topsoil shall be the existing surface soil stripped to the depth indicated and stockpiled on the site in accordance with Section 02935 TURF. Additional topsoil, if required, beyond that available from stripping operations, shall be delivered. Delivered topsoil shall conform to topsoil requirement specified in Section 02935 TURF and shall be amended as recommended by soil tests for the plants specified.

2.2.1 Soil Test

A soil test shall be performed for pH, particle size, chemical analysis and mechanical analysis to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of plants specified.

2.3 SOIL AMENDMENTS

Soil amendments consist of lime, fertilizer, and organic soil amendments.

2.3.1 Lime

Lime shall be agricultural limestone and shall have a minimum calcium carbonate equivalent of 90 percent and shall be ground to such a fineness that at least 90 percent will pass a 10-mesh sieve and at least 50 percent will pass a 60-mesh sieve.

2.3.2 Fertilizer

Fertilizer shall be commercial grade, free flowing, uniform in composition and conforming to CID A-A-1909.

2.3.2.1 Dry Fertilizer

a. Controlled-Release Fertilizer: Consists of nitrogen-phosphorous-potassium ratio: 8 percent nitrogen, 12 percent phosphorous, and 12 percent potassium. Controlled-release fertilizer may be in packet or tablet form.

2.3.2.2 Liquid Fertilizer

Commercially available liquid fertilizer shall consist of completely soluble plant foods suitable for application as foliage spray.

2.3.3 Organic Soil Amendments

2.3.3.1 Peat

Peat shall be a natural product of hypnum moss peat or peat humus derived from a bog, swampland or marsh and shall conform to ASTM D 2607.

2.3.3.2 Sand

Sand shall be clean and free of toxic materials and at least 95 percent by weight shall pass a 10-mesh sieve, and 10 percent by weight shall pass a 16-mesh sieve.

2.3.3.3 Decomposed Wood Derivatives

Decomposed wood derivatives shall be ground bark, sawdust, or other wood waste material free of stones, sticks, and toxic substances harmful to plants and stabilized with nitrogen and having the following properties:

Particle size	Minimum percent by weight passing
No. 4 mesh screen	95
No. 8 mesh screen	80

Nitrogen Content	Minimum percent based on dry weight
Redwood Sawdust	0.5
Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.4 Aluminum Sulfate Soil Conditioner

For single use or in combination to meet requirements for topsoil. Aluminum sulfate shall be commercial grade.

2.4 MULCH

Mulch shall be free from weeds, mold and other deleterious materials.

2.4.1 Organic Mulch Material

Organic mulch materials shall be ground or shredded bark as indicated below:

Product	Length
Southern Pine Mulch	Less than 1-1/2
Hardwood Bark Mulch (wood content not exceeding 15% total weight)	Less than 3
Cypress Mulch (wood fiber content not exceeding 15% total weight)	Less than 3

2.5 GEOTEXTILE

2.5.1 Woven Polypropylene

Woven polypropylene shall be bi-directional, weigh a minimum 4 ounces per square yard, be a minimum 10 mils thick and come in 6 feet wide rolls.

2.5.2 Nonwoven Polypropylene

Nonwoven polypropylene shall be spunbonded, water permeable, non-brittle, weigh a minimum 4 ounces per square yard, be a minimum 10 mils thick and come in 6 feet wide rolls.

2.5.3 Nonwoven polyester

Nonwoven polyester shall be spunbonded, water permeable, non-brittle, weigh a minimum 4 ounces per square yard, be a minimum 10 milsthick and come in 6 feet wide rolls.

2.6 GUYING AND STAKING MATERIAL

2.6.1 Stakes

Stakes for tree support shall be rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Standard stakes shall be hardwood or fir treated with pentachlorophenol.

2.6.1.1 Bracing Stakes

Bracing stakes shall be a minimum of 2 inches by 2 inches or 2-1/2 inches in diameter by 8 feet long and pointed at one end.

2.6.1.2 Ground Stakes

Ground stakes shall be a minimum of 2 inches by 2 inches or 2-1/2 inches in diameter by 3 feet long and pointed at one end.

2.6.2 Guying Material

2.6.2.1 Guying Wire

Guying wire shall be 12-gauge annealed galvanized steel wire.

2.6.2.2 Guying Cable

Guying cable shall be a minimum of five-strand, 3/16-inch diameter cadmium plated steel cable.

2.6.3 Chafing Guard

Chafing guards shall be two inch webbing or carpet strips with a metal grommet and shall be all the same color on the project.

2.7 WATER

Water shall not contain elements toxic to plant life.

2.8 EROSION CONTROL MATERIAL

2.8.1 Soil Erosion Control Blanket

Blanket shall be machine-produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either knitted straw blanket-like mat-construction, covered with biodegradable plastic mesh, or interwoven with biodegradable thread, plastic netting or twisted kraft paper cord netting.

2.8.2 Soil Erosion Control Fabric

Control fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall last 6 to 8 months.

2.8.3 Soil Erosion Control Net

Control net shall be heavy, twisted jute mesh weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.8.4 Anchors

Erosion control anchors shall be as recommended by the manufacturer.

2.9 TREE WOUND DRESSING

Tree wound dressing shall be a black asphalt-base antiseptic paint.

2.10 Pesticide

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide, and miticide. Pesticide material shall be labeled for use and applied only as registered by EPA and approved herbicide, insecticide, fungicide, nematocide, rodenticide, and miticide.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Verify Grades

The Contracting Officer shall verify the finished grades are as indicated on drawings, and the placing of topsoil and smooth grading has been completed in accordance with Section 02210 GRADING.

3.1.2 Underground Obstructions to Planting

The location of underground utilities and facilities shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

3.2 SITE PREPARATION

3.2.1 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material locations may be adjusted by the Contracting Officer to meet field conditions.

3.2.2 Protection of Existing Vegetation

If lawns have been established prior to planting operations, the surrounding turf shall be covered before excavations are made in a manner that will protect turf areas. Existing trees, shrubbery, and beds that are to be preserved shall be barricaded in a manner that will effectively protect them during planting operations.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground or Poor Drainage

When obstructions below ground or poor drainage affect the contract operation, proposed adjustments to plant location, type of plant and planting method or drainage correction shall be submitted to and approved by the Contracting Officer.

3.3.2 Turf Removal

Where planting beds occur in existing turf areas, the turf shall be removed to a depth that will ensure the removal of the entire root system.

3.3.3 Plant Pits

Plant pits shall be dug to produce vertical sides and flat, uncompacted bottoms. When pits are dug with an auger and the sides of the pits become glazed, the glazed surface shall be scarified. The minimum allowable dimensions of plant pits shall be 6 inches deeper than the depth of ball or the depth of base roots; for ball or root spreads up to 2 feet, pit diameters shall be twice the root spread; for ball or root spreads from 2 to 4 feet, pit diameters shall be 2 feet greater; for ball or root spreads over 4 feet, pit diameters shall be 1-1/2 times the ball root spread.

3.4 PERCOLATION TEST

Test for percolation shall be done to determine positive drainage of plant pits and beds. The Contracting Officer shall be notified in writing of all soil and drainage conditions detrimental to growth of plant material and shall submit proposal for correcting the condition.

3.5 PLANTING TIMES AND CONDITIONS

3.5.1 Deciduous Planting Time

Install deciduous plants from 15-Feb to 15-Apr and 1-Oct to 1-Dec.

3.5.2 Evergreen Planting Time

Install evergreen plants from 15-Feb to 1-Jun and 1-Sep to 1-Dec.

3.5.3 Planting Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted to and approved by the Contracting Officer.

3.6 INSTALLATION

3.6.1 Erosion Control

Where erosion control material is indicated or required, material shall be installed in accordance with manufacturer's instructions. Placement of the erosion control material shall be accomplished without damage to installed material or without deviation to finished grade.

3.6.2 Backfill Soil Mixture

The backfill soil mixture shall be a proportioned mixture thoroughly mixed by volume of topsoil and selected soil amendments as follows:

Topsoil 5 parts to mixture.

Soil Amendment 1 part mixture.

3.6.3 Setting Plants

Plants shall be set plumb and held in position until sufficient soil has been firmly placed around roots or ball. Plants shall be set in relation to surrounding grade so that they are even with the depth at which they were grown in the nursery, or container.

3.6.4 Controlled-Release Fertilizer

Controlled-release fertilizer shall be placed in packet or tablet form in the plant pit in the immediate vicinity of the feeding roots in accordance with the manufacturer's recommendations.

3.6.5 Balled and Burlapped Plants

Materials shall be removed that are metal, plastic, nylon or treated burlap, prior to backfilling. Balled and burlapped stock shall be backfilled with topsoil to approximately half the depth of the ball and then tamped and watered. Biodegradable burlap and tying material shall be carefully opened and folded back. The backfill shall be completed, tamped and watered. A 4-inch high earth saucer shall be formed around individual plants.

3.6.6 Bare-Root Plants

Bare-root plants shall be installed by arranging the roots in a natural position. Damaged roots shall be removed with a clean cut. Bare-root (BR) plants shall be backfilled with topsoil carefully worked in among the roots. The backfill and water shall be completed. A 4-inch high earth saucer shall be formed around individual plants.

3.6.7 Container-Grown, Balled and Platformed and Balled and Potted Plants

Non-biodegradable containers or platforms shall be removed without damage to the plant or root system. Biodegradable containers shall be split. The backfill shall be completed as specified for BB plants.

3.6.8 Staking and Guying

3.6.8.1 One Bracing Stake

Trees 4 to 6 feet tall shall be held in place with one bracing stake. The tree shall be held firmly to the stake with a double strand of wire. A chafing guard shall be used where the wire contacts the tree. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or roots.

3.6.8.2 Two Bracing Stakes

Trees over 6 feet tall shall be held in place with two bracing stakes placed on opposite sides. The tree shall be held firmly between the stakes with a double strand of wire. Chafing guards shall be used where the wire contacts the tree. Bracing stakes shall be driven vertically into firm ground and shall not injure the ball or roots.

3.7 FINISHING

3.7.1 Plant Beds

Planted areas shall be uniformly edged to provide a clear-cut division line between the planted area and the adjacent turf area and to provide a shape as indicated. The entire planted area shall be raked and smoothed while maintaining the earth saucers.

3.7.2 Pruning

The total amount of foliage shall be pruned by one-fourth to one-third on installed trees and shrubs to compensate for loss of roots and transplanting shock. The typical growth habit of individual plants shall be retained. Clean cuts shall be made flush with the parent trunk. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth shall not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off." Cuts or wounds measuring a minimum 1/2 inch in diameter shall be painted with the specified tree wound dressing.

3.7.3 Mulch

Mulch shall be spread to a uniform thickness of 4 inches within 48 hours after planting. Mulch shall be kept out of the crowns of shrubs and off buildings, sidewalks and other facilities.

3.7.4 Geotextile

When required for weed control, geotextile shall be placed in accordance with the manufacturer's recommendations and/or as indicated.

3.7.5 Water

Plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. Run-off, puddling and wilting shall be prevented.

3.8 MAINTENANCE DURING PLANTING OPERATION

Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the plant establishment period commences. The maintenance includes watering, pruning, wound dressing, straightening and other necessary operations. Plant beds and earth saucers shall be kept free of weeds, grass and other undesired vegetation. Plants shall be checked for settlement and shall be reset proper grade as necessary. Run-off, puddling and wilting shall be prevented.

3.9 Application of Pesticide Material

When pesticide becomes necessary to remove a disease or pest, a state-certified applicator shall apply required pesticide in accordance with State EPA label restrictions and recommendations. Hydraulic equipment shall be provided for the liquid application of pesticides with a leak-proof tank, positive agitation methods, controlled application pressure and metering gauges. A pesticide treatment plan shall be provided to the Contracting Officer as specified in paragraph SUBMITTALS.

3.10 RESTORATION AND CLEAN UP

3.10.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.10.2 Clean Up

Excess and waste material from the planting operation shall be removed and disposed of off the site. Adjacent paved areas shall be cleared.

3.11 Plant Establishment Period

3.11.1 Commencement

On completion of the last day of the planting operation, the plant establishment period for maintaining installed plants in a healthy growing condition shall commence and shall be in effect for the remaining contract time period not to exceed 12 months. When the planting operation extends over more than one season or there is a variance to the planting times, plant establishment periods shall be established for the work completed, as directed. Written calendar time period shall be furnished to the Contracting Officer for the beginning of the plant establishment period. When there is more than one plant establishment period, describe the boundaries of the planted area covered for each period.

3.11.2 Maintenance During Establishment Period

3.11.2.1 General

Maintenance of plants shall include straightening plants, tightening stakes and guying material, repairing tree wrapping, protecting plant areas from erosion, maintaining erosion control material, supplementing mulch, accomplishing wound dressing, removing dead or broken tip growth by pruning, maintaining edging of beds, checking for girdling of plants and maintaining plant labels, watering, weeding, removing and replacing unhealthy plants. All guying and wiring material shall be removed at the end of the plant establishment period unless otherwise indicated.

3.11.2.2 Water

The plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of one inch of absorbed water per week delivered in the form of natural rain or augmented as required by periodic watering. Run-off, puddling and wilting shall be prevented.

3.11.2.3 Weeding

Grass and weeds in earth saucers and plant beds shall not be allowed to reach a height of 3 inches before being completely removed, including the root growth.

3.11.2.4 Unhealthy Plants

A plant shall be considered unhealthy or dead when the main leader has died back, or 25 percent of the crown is dead. Determine the cause for an unhealthy plant. Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit.

3.11.2.5 Fertilizing

The plants shall be topdressed at least once during the period of establishment with dry fertilizer at the rate of 15 pounds per 100 square feet of plant pit or bed area or foliar feed plants with liquid fertilizer. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

3.11.2.6 Settlement

Topsoil shall be added to maintain grade and to maintain earth saucers. Serious settlement affecting the setting of the plant in relation to the depth at which it was grown requires replanting in accordance with paragraph INSTALLATION.

3.11.2.7 Pesticide Treatment

Treatment for diseases or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE MATERIAL.

3.11.2.8 Maintenance Report

A written record shall be furnished to the Contracting Officer of the maintenance work performed, the quality of plant losses, cause for plant loss and replacements made on each site visit.

3.11.2.9 Maintenance Instructions

Written instructions shall be furnished to the Contracting Officer for year-round care of installed plants.

3.11.3 Replacement Plants

Plants shall be provided for replacement in accordance with paragraph PLANTS. Replacement plants shall be installed in accordance with paragraph INSTALLATION. No extended plant establishment period Shall be required for replacement plants. A plant will be replaced in accordance with paragraph WARRANTY.

3.12 FINAL ACCEPTANCE

3.12.1 Preliminary Inspection

Prior to the completion of the contract or the plant establishment period, whichever occurs first a preliminary inspection shall be held by the Contracting Officer. Time for the inspection will be established in writing. The quantity and type of plants installed and the acceptability of the plants in accordance with the plant establishment period shall be determined.

3.12.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing. Acceptance of the planting operation is subject to the guarantee of plant growth.

-- End of Section --